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THESIS

**ANALYSIS OF HISTORICAL MATERIEL RETURN PROGRAM
(MRP) CREDITS AT THE 1ST MARINE LOGISTICS GROUP
REPARABLE ISSUE POINT (RIP)**

by

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December 2011

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CREDITS AT THE 1ST MARINE LOGISTICS GROUP REPARABLE ISSUE
POINT (RIP)**

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ABSTRACT

Materiel Returns Program (MRP) credits have increased 1st Marine Logistics Group's (1st MLG) total obligation authority by an average of 27% annually since 2008. However, 1st MLG has been unable to leverage the MRP in budget execution due to an inability to forecast future credits.

The purpose of this research is to determine whether analysis of historical MRP credits at 1st MLG could enable the comptroller to forecast future credits, which would enable 1st MLG to leverage MRP credits and budget more efficiently in a constrained fiscal environment. This research utilized descriptive analysis of historical credits to identify systemic patterns or trends associated with MRP. The analysis of MRP credits focused on two specific areas: (1) the accuracy of credit estimates provided by the sources of supply (SOSs), and (2) the amount of time it took for 1st MLG to receive the actual credit.

The primary finding of this research was that 1st MLG should be able to forecast MRP credits. The research showed that historically over a two-year period, SOSs accurately estimated credits 88.3% of the time and SOSs issued 95% of all actual credits within 90 days of 1st MLG submitting an item into MRP.

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LIST OF ACRONYMS AND ABBREVIATIONS

1st Maint BN	1st Maintenance Battalion
3PL	Third-Party Logistics
AAC	Activity Address Code
ACALA	Armament and Chemical Acquisition and Logistics Command
BEA	Budget Execution Activity
CAL	Consolidated Asset List
CECOM	Communications–Electronics Command
CLB	Combat Logistics Battalion
CLC	Combat Logistics Company
DIC	Document Identifier Code
DLA	Defense Logistics Agency
DLR	Depot-Level Repairables
DoD	Department of Defense
DRMO	Defense Reutilization Marketing Office
DSSC	Direct Support Stock Control
DTR	Daily Transaction Report
EOM	Echelon of Maintenance
ERQ	Economic Retention Quantities
ESD	Enterprise Sourcing Decision
FEDLOG	Federal Logistics Data
FLR	Field-Level Repairable
FSC	Federal Supply Classification
FY	Fiscal Year
GC	Ground Common
GCSS–MC	Global Combat Support System–Marine Corps
HMMWV	High Mobility Multi Wheeled Vehicle
IMA	Intermediate Maintenance Activity

LD	Low Density
LIS	Logistics Integrated Support
LOGCOM	Logistics Command
LOGMOD	Logistics Modernization
LOM	Levels Of Maintenance
MARCORLOGCOM	Marine Corps Logistics Command
MCAGCC	Marine Corps Air Ground Combat Center
MCAS	Marine Corps Air Station
MCO	Marine Corps Order
MCSC	Marine Corps Systems Command
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MLG	Marine Logistics Group
MRP	Materiel Returns Program
NSN	National Stock Number
O&M	Operations and Maintenance
OIC	Officer in Charge
OST	Order-Ship Time
PEI	Principal End Item
POP	Proof of Principal
RCT	Repair Cycle-Time
RIC	Routing Identifier Code
RIP	Reparable Issue Point
RMC	Reparable Management Company
RO	Requisitioning Objective
ROM	Realignment Of Maintenance
SABRS	Standard Accounting, Budgeting, and Reporting System
SAS	Set Assembly System
SASSY	Supported Activity Supply System
SDN	Standard Document Number
SDR	Secondary Depot Repairable
SECREP	Secondary Repairable
SINGARS	Single Channel Ground and Airborne Radio System
SOS	Source of Supply
TACOM	Tank, Automotive, and Armaments Command

USA
USAF
USMC
USN

United States Army
United States Air Force
United States Marine Corps
United States Navy

WIP

Work in Progress

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I. INTRODUCTION

In the wake of what Brigadier General Frank Kelley, Commander Marine Corps Systems Command (MCSC), has called the “bloated budgets” (as cited in Hoffman, 2011) of the past 10 years, the Department of Defense (DoD) is bracing for what are generally accepted to be significant budget cuts. In fact, current discussions on the subject of defense budgeting tend to include terminology such as fiscal austerity and constrained resources. The DoD is seeking to eliminate inefficiency and squeeze out every last bit of utility from every dollar. These financial challenges are currently being felt at 1st Marine Logistics Group (1st MLG) where Operations and Maintenance (O&M) funding alone is \$2 million less for fiscal year (FY) 2012 than it was in FY2011 (S. Goodwin, personal communication, October 11, 2011). In his annual budget formulation guidance, the commanding general, 1st MLG echoes Brigadier General Kelley’s sentiments, charging his commanders and staff to adopt “pre-9/11 budget management best practices” and to be “vigilant stewards of limited resources” (Hudson, 2011, p. 1). Despite its constrained resources, 1st MLG undoubtedly will not experience any corresponding reduction in its operational requirements. 1st MLG, along with every other unit in the Marine Corps, must find ways to do more with less.

1st MLG has a unique fiscal opportunity despite the constrained resources expected in years to come. Between FY2008 and FY2010, 1st MLG received, on average, \$15.6 million in credits per year through the Materiel Returns Program (MRP). However, despite MRP credits essentially increasing its total obligation authority by as much as 27% annually, 1st MLG has been unable to forecast expected credits, preventing it from leveraging MRP to more effectively resource subordinate units.

Historically, 1st MLG has been unable to leverage MRP credits in budget execution because it has not been able to accurately track how much credit they were going to receive or when the expected credits would post.

The inability to forecast expected credits can be attributed primarily to the difficulty in consolidating and analyzing the data required from multiple legacy systems.

The 1st MLG comptroller initiated this research topic, specifically requesting an analysis of historical and expected Materiel Return Program (MRP) credits at the 1st MLG Reparable Issue Point (RIP). 1st MLG was seeking a more efficient way to resource subordinate units while developing budgets in a constrained fiscal environment. One method being considered by 1st MLG was to more effectively leverage MRP credits in budget planning and execution by forecasting the amount and timing of credits they will receive in the future.

With our research, we attempted to assist the 1st MLG comptroller to determine whether it is possible to forecast MRP credits by answering the questions outlined in Sections A and B.

A. PRIMARY QUESTION

Can expected Materiel Returns Program (MRP) credits be forecasted at 1st Marine Logistics Group (1st MLG)?

B. SECONDARY QUESTIONS

- What are the differences between 1st MLG's estimated MRP credits and the actual credits it received?
- What percentage of MRP credits does 1st MLG receive within 30, 90, and 180 days of submitting a new MRP document to the source of supply (SOS)?

To answer these questions, we analyzed historical credits from January 2008 to June 2011 to identify key trends pertaining to how many credits 1st MLG received and how long it took for those credits to post.

C. RESEARCH OBJECTIVES

The overall objective of our thesis is to identify trends associated with MRP credits that may enable 1st MLG to forecast expected credits and that may

assist with future resource distribution. Specifically, the intent of our thesis is to determine whether analysis of historical MRP credits can be used to forecast expected credits. We identified two specific areas for analysis that we believe can be used to determine whether forecasting MRP credits is possible: (1) the difference in estimated and actual credits and (2) the time between 1st MLG submitting an item to a SOS through MRP and that SOS issuing a credit to 1st MLG.

In order to determine whether analysis of historical MRP credits could be used to forecast future credits, we needed to analyze all materiel and fiscal transactions associated with selected standard document numbers (SDNs) that generated actual MRP credits. We used our analysis of these transactions to identify systemic patterns or other trends associated with MRP credits at 1st MLG.

D. RESEARCH SCOPE

Our thesis research focuses on the MRP credits generated at 1st MLG's RIP. Specifically, we analyzed the difference between estimated and actual MRP credits and the lead-times associated with 1st MLG receiving those credits.

We did not include an analysis of MRP credits at the enterprise level or at any other command outside of 1st MLG. In addition, we did not analyze the MRP system/process itself or associated human touch points.

Although MRP is used throughout the Marine Corps, only those individuals who work directly with the program on a regular basis tend to understand how the MRP system functions and the impact it has on the fiscal budgeting within the Marine Corps. In Chapter II, we provide the background and context required for someone to fully understand the analysis we present in later chapters. Chapter III defines the research methodology we used in our analysis and explains the limitations associated with our research. In Chapter IV, we present our data analysis. Finally, in Chapter V, we answer our research questions, summarize our conclusions, and recommend areas for future research.

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II. BACKGROUND AND LITERATURE REVIEW

In this chapter, we provide a background on the Marine Corps' organization, maintenance, supply, and fiscal management that facilitates understanding of the data presented and analyzed in Chapter IV. Additionally, we offer details on the Materiel Returns Program (MRP) system, requirements, and process. Overall, in this chapter we introduce topics in a broad context to give perspective and then narrow the topics down to the specific areas on which we focused in our research.

A. SECONDARY REPARABLES

The Marine Corps classifies ground equipment repair parts as consumable and reparable. Consumable repair items cannot be repaired and are discarded when they become unserviceable. This research focused on reparable items, known as secondary reparables (SECREPs), which Marine Corps Order (MCO) P4400.151B (Headquarters, Marine Corps [HQMC], 1992) explains are reparable components/parts of a principal end item (PEI)¹ that are neither consumable, nor functional by themselves. Examples of SECREPs and PEIs include a transmission (SECREP) for a High Mobility Multipurpose Wheeled Vehicle (HMMWV; PEI) or a circuit board (SECREP) for a radar (PEI). SECREPs can be either depot-level reparables (DLRs) or field-level reparables (FLRs).

DLR items can only be repaired at the depot level. MCO P4400.82 (HQMC, 1985a) directs units to report SECREPs that are beyond the repair capability of lower maintenance echelons to Marine Corps Logistics Command (MARCORLOGCOM) for disposition instructions. According to MCO P4400.151B (HQMC, 1992), DLRs must meet one of the following criteria:

¹ MCO P4400.150E (HQMC, 1999b) defines *principal end item* (PEI) as “nonexpendable items of such importance that they require centralized management” (p. 1–9). PEIs are selected based on the following criteria: “essential for combat or training; high monetary value; difficult to procure or produce; and criticality of basic materials or components” (HQMC, 1999b, p. 1–9). Examples of PEIs include the AN/TPQ-37 Firefinder radar system and M1A2 Abrams main battle tank.

- The item cannot be assembled in the field from finished parts authorized for supply-system stockage;
- Rebuild at lower than depot level is impractical or will adversely diminish the mobility or dilute the maintenance support capability of the operator-level unit; or
- Repair/rebuild requires skills, tools, test equipment, or facilities not available locally.

MCO P4400.151B (HQMC, 1992) states that FLR items are repaired “at the lowest echelon of maintenance² authorized to affect the required action” (p. 5-5). FLRs are repaired by field maintenance activities such as the Maintenance Battalion within the Marine Logistics Group, which we discuss in greater detail later in this chapter. In later chapters, we make no distinction between DLR and FLR items; they are both referred to as SECREPs.

1. Categories of SECREPs

SECREPs are broken down into two categories, ground common (GC) and low density (LD). The difference between the two categories stems from the type of principle end item (PEI) that requires the SECREP and the activity that is authorized to perform maintenance on the SECREP.

a. *Ground Common*

Most SECREPs fall into the ground common account (AAC³: MMFAG8), which consists primarily of SECREPs for ground vehicle PEIs. An example of the ground common account is a transmission (SECREP) for a HMMWV (PEI). Using units do not retain the capability or authority to perform maintenance on ground common SECREPs.

² Appendix A provides an overview of the USMC echelons of maintenance.

³ DoD 4400.25-6-M (DoD, 1996) defines Activity Address Code (AAC) as a “six position (alpha-numeric) code that uniquely identifies a unit, activity, or organization that has the authority to requisition and/or receive material” (p. xiii).

b. Low Density

All other SECREPs fall into the low density account (AAC: MMFAG3) and are components to specialized PEIs, such as a circuit board (SECREP) for a radar system (PEI). Unlike ground common SECREPs, the units that own and operate the PEI retain the capability and authority to perform maintenance on low density SECREPs (J. R. Copley, personal communication, June 2, 2011).

B. 1ST MARINE LOGISTICS GROUP

1. 1st Marine Logistics Group

1st Marine Logistics Group (1st MLG) is the logistics combat element of I Marine Expeditionary Force (I MEF),⁴ located at Camp Pendleton, CA. 1st MLG's mission is to "provide direct support to the Marine Expeditionary Force (MEF) Ground Combat Element (GCE) and general support and sustained tactical-level logistics support above the organic capabilities of supported elements of the MEF" (USMC, 2011b, Mission). 1st MLG accomplishes its assigned mission by performing the six functions of logistics for I MEF. MCDP-4 (HQMC, 1997a) identifies the six functional areas of logistics as "supply, maintenance, transportation, general engineering, health services, and other services, which include legal, exchange, food, disbursing, postal, billeting, religious, mortuary, and morale and recreation services" (p. 47). The supply and logistics functional areas are directly related to our research of MRP usage within 1st MLG's Repairable Issue Point (RIP).

1st MLG is composed of a headquarters element and three Combat Logistics Regiments (CLRs), as indicated by the command structure depicted in Figure 1.

⁴ MCRP 5-2A (1997b) defines the Marine Expeditionary Force (MEF) as "the Marine Corps' principal warfighting organization and sole standing Marine Air-Ground Task Force (MAGTF) that exist in peacetime, as well as war" (HQMC, p. 1-97). A MEF's size and composition can be tailored for specific operational requirements, but they generally consist of a standing command element (CE), a Ground Combat Element (GCE), an Aviation Combat Element (ACE), and a Logistics Combat Element (LCE).

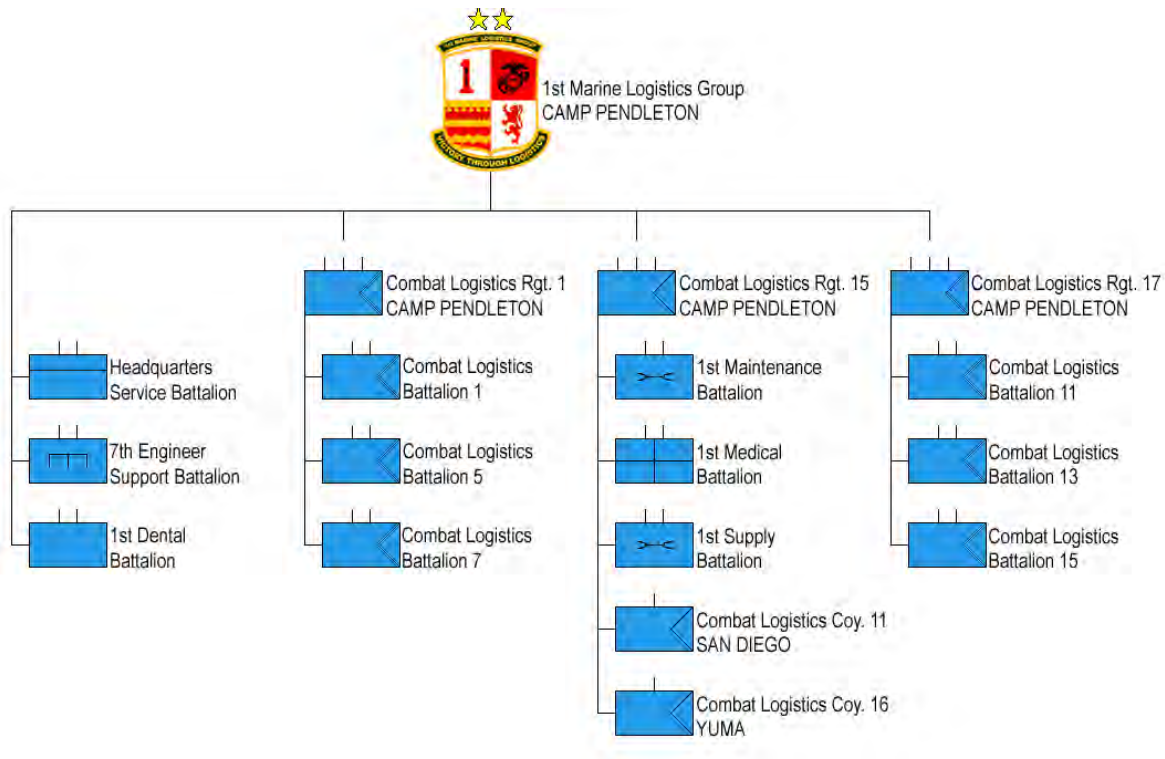


Figure 1. 1st MLG Command Structure (From USMC, 2011a)

2. Combat Logistics Regiment 15

Of the three regiments within 1st MLG, CLR-1 and CLR-17 directly support the individual infantry regiments and the Marine Expeditionary Units (MEUs) within I MEF. In our thesis, we focus on CLR-15, which is in general support of the entire I MEF. The CLR-15 website (USMC, 2011c) describes the command's mission as providing "intermediate level supply support, field level maintenance support, materiel distribution support, procurement management, and equipment fielding support." CLR-15's objectives, as stated by the commanding officer (as cited in USMC, 2011c), are to "overcome excessive order-ship times (OSTs), reduce total repair cycle-times (RCTs), and eliminate backorders ... by partnering with supply chain and distribution experts to include commercial resources." The intermediate-level supply support component of

CLR-15's mission directly pertains to SECREP management and operation of the MRP, which is the focus of this research. All subsequent units and activities we discuss in this chapter have direct roles in these functions.

3. 1st Maintenance Battalion

As a subordinate element of CLR-15, 1st Maintenance Battalion (1st Maint BN) is responsible for “providing general support (GS) and task-organized direct support (DS) field-level maintenance support for Marine Corps-furnished tactical ordnance, engineer, motor transport, communications-electronics, and general support equipment of the MEF” (1st Maint BN, 2011, p. 3). 1st Maint BN's essential tasks, as stated in the battalion's command brief (1st Maint BN, 2011), include the following tasks:

- Provide intermediate-level maintenance support,⁵ to include wheeled and tracked vehicle recovery, salvage and disposal, and general maintenance support, for I MEF's ground equipment.
- Provide secondary reparable management, including inventory management, storage, financial accounting, and maintenance for secondary reparables. (1st Maint BN, 2011, p. 6)

1st Maint BN is composed of a headquarters element and four subordinate companies, each responsible for specific components of the battalion's mission, as indicated in Figure 2. Our research focused exclusively on the Reparable Management Company (RMC).

⁵ Intermediate-level maintenance is “performed by designated activities with specially trained mechanics or technicians... and includes inspection/in-depth diagnosis, modification, replacement, adjustment, and limited repair or evacuation/disposal of principle end items and their selected reparables and components/sub-components. Intermediate-level maintenance also includes calibration and repair of test, measurement and diagnostic equipment (TMDE), as well as fabrication of items, precision machining, and various methods of welding” (HQMC, 1994, p. 1–4). Appendix A explains the USMC echelons of maintenance in greater detail.

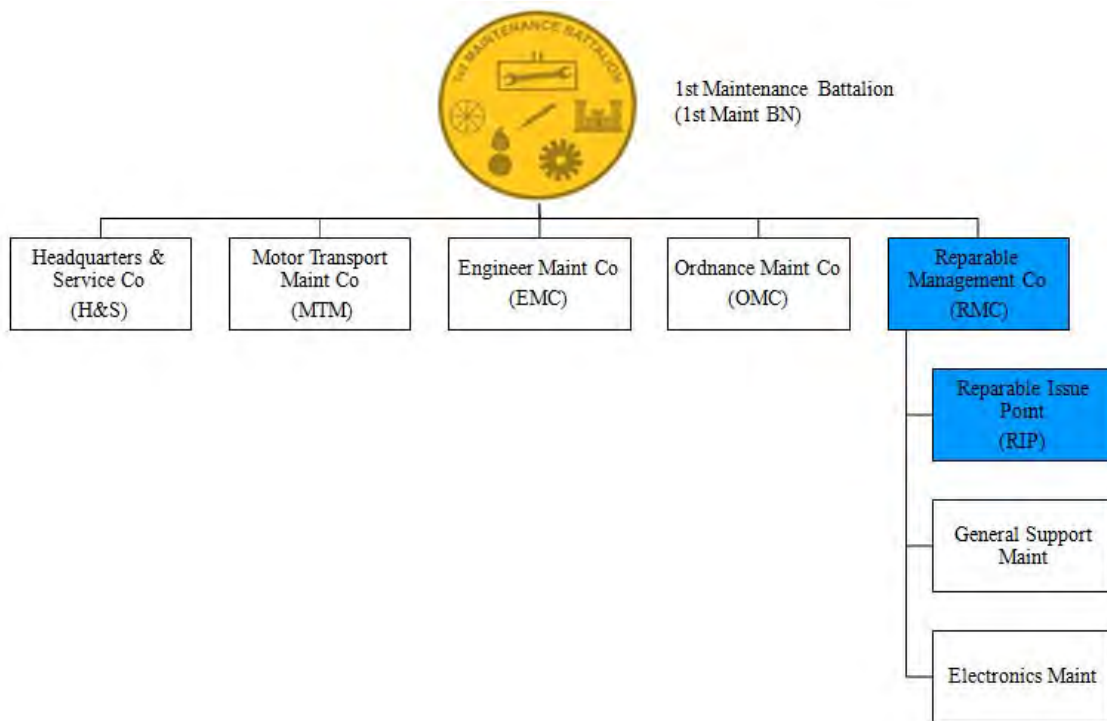


Figure 2. 1st Maintenance Battalion Organizational Chart (After *1st Maintenance Battalion Command Brief* by 1st Maint BN (2011).

4. Reparable Management Company

According to 1st Maint BN (2011), the RMC supports CLR-15's general support mission in the following ways:

- Providing general support field-level maintenance support⁶ for the MEF's ground communication—electronics, motor transportation, engineer and ordnance equipment
- Providing sourcing, inventory control, fiscal management, disposition, and intermediate maintenance support for ground equipment secondary reparable
- Operating reparable issue points (RIPs)

⁶ MCO P4790.2C (HQMC, 1994) explains that Marine Corps maintenance is divided into field and depot level. Field maintenance includes organizational maintenance, which is the responsibility of the unit that owns the equipment being repaired, and intermediate maintenance, which is performed by "designated activities with specially trained mechanics and technicians" (p. 1–4). Appendix A explains the USMC echelons of maintenance in greater detail.

C. REPARABLE ISSUE POINT (RIP)

1. Mission

The RIP, an intermediate-level supply activity within the RMC, functions as “the sole source for direct exchange of secondary depot reparable (SDR) items and field level reparable (FLR) items ... in support of second, third, and fourth echelon maintenance”⁷ (HQMC, 1992, p. 3–17). As the sole source for SDR and FLR items, the RIP is responsible for centralized SECREP management within the MEF.

2. Organization

An RIP exists within each MEF. I MEF’s RIP is located at Camp Pendleton, CA. Although authorized and established by the commander, Logistics Command (LOGCOM), the RIP is organic to 1st MLG as an activity within the MLG’s maintenance battalion. In addition to the main RIP located at Camp Pendleton, CA, 1st MLG also operates six sub-RIPs to support I MEF ground units that are geographically separated from the main RIP and/or deployed (HQMC, 1992), as depicted in Table 1.

⁷ Appendix A provides an overview of the USMC echelons of maintenance.

Table 1. Summary of 1st MLG Sub-RIPs

Summary of 1st MLG Sub-RIPs		
Command	Location	Reason
Combat Logistics Battalion 7 (CLB-7)	Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, CA	Support I MEF ground units home stationed at MCAGCC
Exercise Support Division	MCAGCC, Twentynine Palms, CA	Support ground units participating in exercise forces training aboard MCAGCC
Combat Logistics Company 16 (CLC-16)	Marine Corps Air Station, Yuma, AZ	Support tenant and augment ground units at Marine Corps Air Station (MCAS) Yuma
11th, 13th, & 15th Marine Expeditionary Units (MEUs)	Camp Pendleton, CA	Support I MEF ground units forward deployed as part of the MEU.

Note. This table was created from data we received from 1st MLG.

According to MCO P4400.151B (HQMC, 1992), 1st MLG's sub-RIPs are assigned separate activity address codes (AACs), manage their own assigned assets, and maintain separate accounting records. However, the main RIP at Camp Pendleton maintains visibility of the sub-RIPs, exercises overall materiel and financial control of their activities, and reports a consolidated asset posture to LOGCOM.

3. RIP Process Overview

Upon receipt of an unserviceable SECREP from a customer, RIP management must determine whether the customer requires a serviceable replacement, and, if so, how best to fill that requirement. The RIP has four options to fill a requirement for serviceable SECREPs: (1) repairs by the Intermediate Maintenance Activity (IMA), (2) repairs by the logistics integrated

support (LIS) contractor, (3) enterprise redistribution between RIPs, and (4) MRP. Although all four options are critical to the RIP's ability to manage I MEF's SECREP inventory and support customer supply requirements, in this research, we were only concerned with the RIP's use of MRP and, specifically, the financial credits that system produces for 1st MLG. The RIP's four options for handling SECREPs are illustrated in Appendix B, Reparable Issue Point Process Overview, which depicts in detail the actions associated with centralized SECREP management. It also highlights the decision process used by the RIP to fill customer requirements and support SECREP management at the enterprise level.

The RIP supports the supply process within the MLG by exchanging "unserviceable items turned in by using units for serviceable like items on hand at the RIP" (HQMC, 1992, p. 5–9). Upon receiving an unserviceable SECREP from a customer, the RIP initiates a sequence of three decision points outlined by the *Playbook for the Centralized SECREP Management Proof of Principle Pilot Test*, commonly referred to as the *POP Playbook* (Marine Corps Logistics Command, 2009). The sequence outlined in the *POP Playbook* offers the RIP a template for managing local asset posture in support of enterprise sourcing decisions (ESDs) and meeting customer requirements in the most efficient manner possible. Table 2 displays how the *POP Playbook* assists the RIP leadership with making those decisions.

Table 2. Summary of *POP Playbook* Decision Process (From Marine Corps LOGCOM, 2009)

I. Decision Point:	Is repair necessary to support enterprise inventory?	
Explanation:	The LOGCOM Site Manager, RIP and IMA leadership determine whether a requirement for the SECREP exists by evaluating local and enterprise asset posture, phase-in/out plans, IMA capabilities and workload, diminishing manufacturing sources, etc.	
Possible actions:	If a requirement for the SECREP exists and no excess is available throughout the enterprise, the RIP inducts the item to maintenance at the IMA.	If a requirement for the SECREP does not exist the RIP proceeds directly to the Code F ⁸ decision process.
II. Decision Point:	Code F Disposition Decision Process	
Explanation:	If the LOGCOM Site Manager, RIP, and IMA leadership decide that a requirement does not exist or if IMA determines repair of the SECREP exceeds their capacity or capability, the LOGCOM Site Manager and RIP OIC [officer in charge] will determine what specific action to take on the Code F carcass.	
Possible actions:	If no enterprise requirement exists for the item, the RIP will submit the carcass ⁹ to MRP for carcass credit or dispose of it via the Defense Reutilization Marketing Office (DRMO). DRMO is only an option for FLRs.	If requirement for stock replenishment of the item exists (local or enterprise), the RIP will determine whether to induct for repair via 3PL or request disposition and replenishment via MRP.

⁸ Code F indicates a Defense Logistics Agency (DLA) Supply Condition Code. The *Defense Logistics Agency Customer Service Handbook*, 18th ed., defines Code F as “unserviceable (Reparable); [e]conomically reparable materiel, which requires repair, overhaul, or reconditioning” (DLA, 2011, p. 137).

⁹ MRP classifies SECREPs in two categories, excess and carcass. Excess items can be serviceable or unserviceable and have no requirement for replacement. Carcass items are unserviceable and require replacement to fill a customer requirement or replenish the RIP’s authorized stockage levels.

III. Decision Point:	Enterprise sourcing decision in support of customer backorder	
Explanation:	In the event no Code A ¹⁰ SECREP is on hand to fill a customer requirement for a replacement SECREP, LOGCOM Site Manager, RIP, and IMA leadership must determine optimal method to fill backorder.	
Possible actions:	IMA is the first choice for repairs if the repair cycle time (RCT) is less than the order ship time (OST) associated with MRP exchange or 3PL repairs.	The LOGCOM Site Manager will coordinate for redistribution within the enterprise if repair options are less timely than redistribution and if it is justified by the criticality of the SECREP.

These decision points are important in order to understand the process the RIP uses to manage SECREPs and to understand where the MRP fits into that process. However, the decision points themselves are outside the scope of this thesis, in which we are primarily concerned with the MRP credits, regardless of where in the process they were generated.

4. RIP Inventory Management

The RIP is the sole activity within the MEF authorized to stock SDRs and FLRs. As such, the RIP is responsible for managing the asset posture of those items for the MEF by managing allowances and on-hand assets (HQMC, 1992). The RIP officer in charge (OIC), in coordination with the LOGCOM site manager and the IMA, determines materiel allowances through an annual recomputation based on using unit historical item usage. During this process, the RIP OIC establishes requisition objectives (RO) and buy lists for all SECREPs maintained by the RIP. The RIP OIC also has the flexibility to manage the inventory allowance based on their understanding of Enterprise-Sourcing Decisions (ESDs), repair cycle-times (RCTs) for the IMA, and OSTs for SOSs, and third-party logistics (3PL), enabling the RIP OIC to determine economic retention quantities (ERQs) that usage data alone does not necessarily support (J. R. Copley, personal communication, June 7, 2011).

¹⁰ Code A indicates a DLA Supply Condition Code. The *Defense Logistics Agency Customer Service Handbook*, 18th ed., defines Code A as “serviceable; new, used, repaired, or reconditioned materiel, which is serviceable and issuable to all customers without limitation or restriction” (DLA, 2011, p. 137).

To manage on-hand inventory, the RIP OIC uses a consolidated asset listing (CAL), which is a report that can be pulled daily. The CAL provides a snapshot of the RIP's complete on-hand inventory by location (main RIP and sub-RIPs). It includes items due from SOSs, 3PL, enterprise redistribution, and those items that are currently work in process (WIP) at the IMA.

5. RIP Budget and Fiscal Management

The RIP operates two budget execution activities (BEAs),¹¹ one each for the low-density account (MMFAG3) and the ground common account (MMFAG8). Although each of the six sub-RIPs within 1st MLG maintain separate accounting records, all SECREPs are funded and managed centrally by the main RIP at Camp Pendleton. All financial transactions of the sub-RIPs are processed through the main RIP under the two overall BEAs, making the sub-RIPs transparent to the MLG comptroller.

D. MATERIEL RETURNS PROGRAM (MRP)

The MRP and, specifically, the credits generated by that system, were our focus in this research. In the remainder of this section, we provide an overview of the system, describe how the RIP uses it, and explain how the MRP interfaces with Marine Corps property and fiscal management systems.

1. Purpose

The MRP is an automated system that facilitates the RIP's reporting of materiel excesses and carcass returns to the SOS, processes responses from the SOS to the RIP, provides output to the parent inventory and financial subsystems for reconciliation and reporting requirements, and generates output reports that facilitate the RIP's management of excesses and carcass returns (HQMC, 2007, p. 1–2).

¹¹ MCO 7300.21A (HQMC, 2008) defines Budget Execution Activity as “subdivisions of Work Centers... where legal responsibility for the proper management of the funds is retained” (p. C–3).

2. MRP System

As stated in the UM 4400-60 (HQMC, 2007), “the parent inventory systems hosted by the MRP are DSSC,¹² Set Assembly System (SAS),¹³ and SASSY.¹⁴ MRP also interfaces with the Standard Accounting, Budgeting and Reporting System (SABRS) financial system” (p. 1–2). The MRP system operates with a MRP Master File for each parent system and interfaces with the parent system inventory files. MRP is a standard automated system that will:

- Facilitate the reporting of materiel excesses/carcass returns;
- Process excess responses from the source of supply;
- Provide output to the SASSY, DSSC, and SAS systems causing the reduction of inventory and generation of issue transactions and financial data;
- Provide expected credit documents to SABRS financial system; and
- Provide output reports/management reports to the SASSY Management Unit (SMU) and the Reparable Issue Point (RIP), the DSSC, and SAS to facilitate the management of excesses reported and/or carcass returns (HQMC, 2007, pp. 2–6).

The parent inventory and financial systems make up a complex network of databases. Discussions of that network, and how the MRP interfaces with it, are beyond the scope of this thesis. For detailed information regarding these system relationships, refer to the *Materiel Returns Program Users Manual*, UM 4400-60 (HQMC, 2007).

¹² Direct Support Stock Control (DSSC). The DSSC concept is to position selected types of materials near the actual user to reduce the supply pipeline response time. Refer to *Direct Support Stock Control Users Manual*, UM 4400-76 (HQMC, 1996).

¹³ Set Assembly System (SAS). SAS provides visibility and accountability of assets used in the assembly/disassembly of collection-type items and upgrade to issue, including project orders and actions to assemble materiel under procurement, direct assembly, and the completion of incomplete materiel in stock. Refer to *Automated Set Assembly System Users Manual*, UM 4012-100 (HQMC, 1999a).

¹⁴ Supported Activities Supply System (SASSY).

3. Source of Supply (SOS) Definition

In the context of our research, a source of supply (SOS) is an agency that maintains an inventory of specific items that have been assigned to a federal supply class¹⁵ for use within the Department of Defense (DoD). As shown in Figure 3, the DoD purchases these items from commercial sources and maintains inventories at designated locations to decrease the time a customer (a unit within the DoD) waits to receive a requisitioned item (W. Long, personal communication, April 27, 2011).

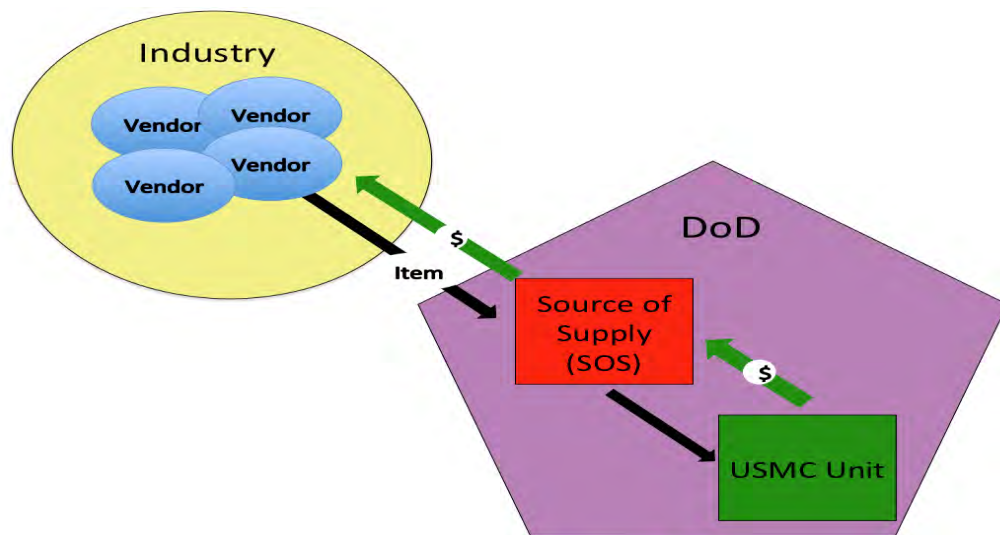


Figure 3. Requisition Process Flow

Our research identified 12 SOSs¹⁶ that 1st MLG uses to manage SECREP inventory through the MRP. As Table 3 indicates, each SOS is operated by an individual service or agency and manages specific commodity items.

¹⁵ The Defense Logistics Agency (DLA; DoD, 2011) defines Federal Supply Classification (FSC) in this way: FSC “identifies the supply classification of an item of supply identified under the federal cataloging program, an item of production and/or a homogeneous area of commodities in respect to their physical or performance characteristics.”

¹⁶ The acronym SOS is interchangeable with *RIC*, Routing Identifier Code. The MRP uses SOS, and SABRS uses RIC.

Table 3. Sources of Supply (SOS) Utilized at 1st MLG (From Defense Logistics Agency [DLA], 2011)

SOS/RIC	Service/Agency	Location	Commodity
SMS	Defense Logistics Agency	DLA centrally managed	Ground vehicle
SG2	Defense Logistics Agency	DLA centrally managed	Fire control and optics (ground)
SDA	Defense Logistics Agency	DLA centrally managed	Ground vehicle
AKZ	U.S. Army	USA Tank and Automotive Command (TACOM), Warren MI	Wheeled and tracked vehicles
B14	U.S. Army	USA Armament & Chemical Acquisition and Logistics Activity (ACALA), Rock Island, IL	Ordnance; Chemical, Biological, Radiological, and Nuclear (CBRN) equipment
B16	U.S. Army	USA Communications-Electronics Command (CECOM), Fort Monmouth, NJ	Communications-electronic (COMELECT) equipment
B64	U.S. Army	USA Aviation and Missile Command (AMCOM), Redstone Arsenal, AL	Ground missile systems
N35	U.S. Navy	Naval Inventory Control Point, Mechanicsburg, PA	Misc electrical equipment; Surface and subsurface equipment
FGZ	U.S. Air Force	Ogden Air Logistics Center, Hill AFB, Ogden, UT	Radio, communication equipment
FLZ	U.S. Air Force	Warner Robins Air Logistics Center, Robins AFB, Warner Robins, GA	Communication, electronic equipment
FHZ	U.S. Air Force	Oklahoma City Air Logistics Center, Tinker AFB, OK	Generator equipment
MPB	USMC	Marine Corps Logistics Command, Albany, GA	Misc. equipment

4. MRP Process and Transactions

RIP management's determination to induct a materiel excess or carcass into the MRP is the first step of an 11-step process. As seen in Figure 4, that decision triggers a series of automated and manually generated transactions between the MRP clerk at the RIP and the item manager at the SOS.

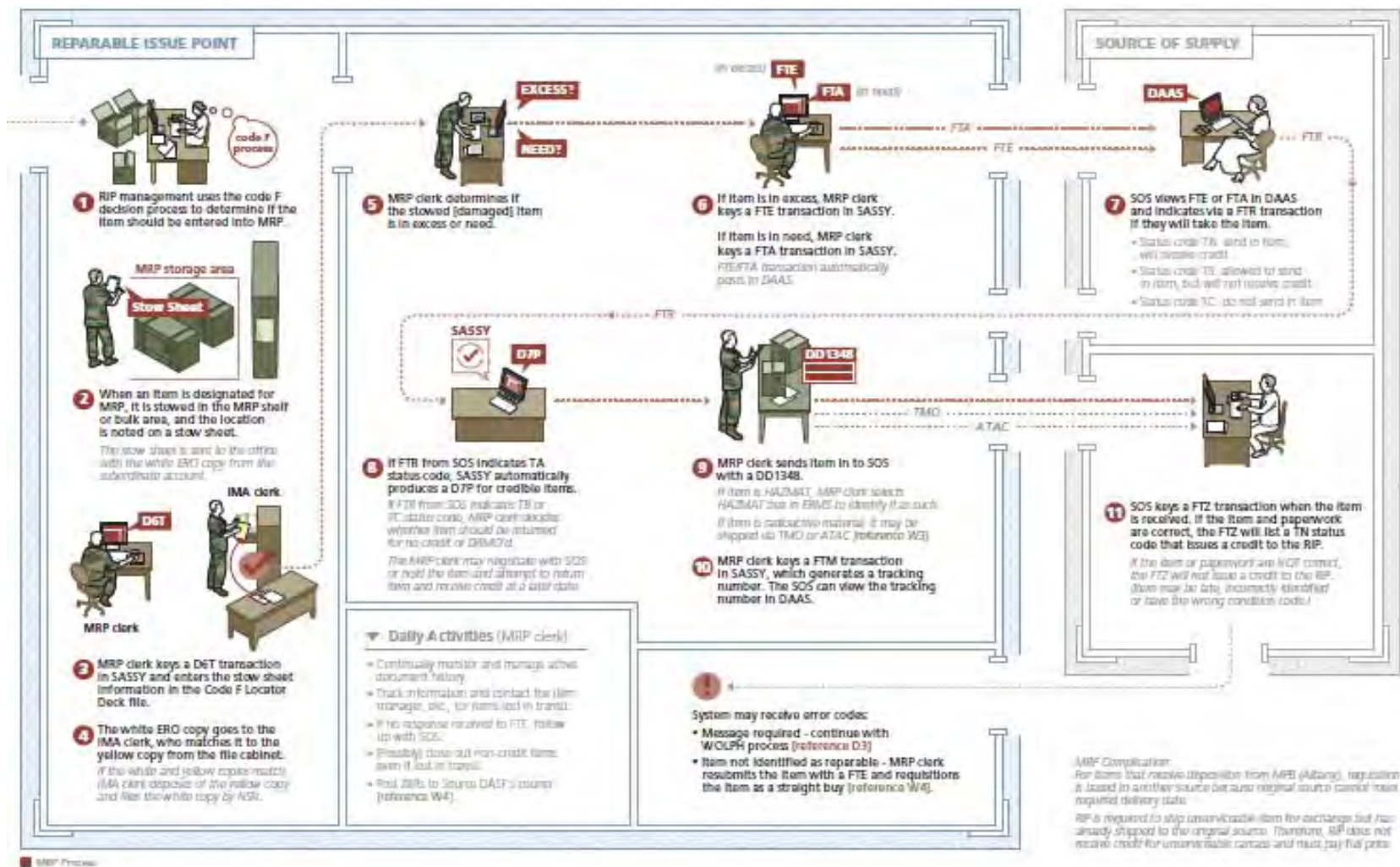


Figure 4. Reparable Issue Point Material Returns Program Process Flow (From Marine Corps LOGCOM, 2009)

In this thesis, we are primarily concerned with transactions associated with Steps 6, 7, and 11 from Figure 4 because they directly affect the generation of MRP credits.

a. *Step 6: Excess or Carcass*

The RIP notifies the SOS of excess or carcass SECREPs by submitting FTE¹⁷ (excess) or FTA (carcass) notification transactions in SASSY. In Chapter IV, we provide an analysis of historical FTE/FTA transactions to determine the variation in the amount of excess and carcass activity and to identify trends associated with the transactions that impact the MRP credits that 1st MLG receives.

b. *Step 7: SOS Review and Response*

After reviewing the FTE/FTA, the SOS responds to the RIP with an FTR transaction indicating whether it will take the SECREP. The SOS's FTR transaction will contain one of three status codes:

- TA—return item to SOS for credit
- TB—return item to SOS (optional) with no credit
- TC—do not return item to SOS. Process for disposal via DRMO

Step 7 is important because it is the first indication of whether the RIP will receive a credit from the SOS. However, our research focused only on the credits the MRP generates in later steps and did not include analysis of FTR transactions.

c. *Step 11: SOS Notification of Credit*

Upon receipt of an excess or carcass SECREP from RIP, the SOS responds with an FTZ transaction. The FTZ transaction serves as the RIP's

¹⁷ FTE, FTA, FTR, FTZ are all supply transaction codes used in MRP.

notification that the SOS has received the excess or carcass SECREP, provides the RIP an expected credit amount in the MRP, and triggers the actual credit to be issued to the RIP in SABRS.

It is important to understand that the credit amount listed on the FTZ transaction in the MRP is only an estimate and does not affect the RIP's financial account. The actual credit amount posts in SABRS. The potential for variation between the expected credit amount generated by Step 11 of the MRP process, and the corresponding SABRS transaction that generates the actual credit amount issued to 1st MLG, was one of the focal points of our research. In Chapter IV, we include a thorough analysis of the two transactions to determine differences and other trends associated with MRP credits. In Chapter IV, we provide an analysis of the lead-times between Steps 6 and 11 to determine statistical trends for all SOSs used by the MRP.

5. MRP Credits

1st MLG receives MRP credits in two ways, depending on the SOS issuing the credit. An SOS will issue a direct financial credit or provide a discounted exchange price on a replacement item.

1st MLG receives actual financial credits from all Defense Logistics Agency (DLA), U.S. Army (USA), U.S. Air Force (USAF), and U.S. Navy (USN) SOSs for items they submit to the MRP. An MRP credit from one of these SOSs translates directly to an increase in 1st MLG's total obligation authority or purchasing power. For example, if AKZ (USA TACOM) issues a \$100,000 MRP credit to 1st MLG, 1st MLG's available funds increase by \$100,000.

Conversely, rather than issuing actual financial MRP credits, MPB (Marine Corps Logistics Command) uses a discounted exchange price on serviceable SECREP replacements. For example, based on the Federal Logistics Data

(FEDLOG)¹⁸ information in Figure 5, if 1st MLG submits an unserviceable tank engine to the MRP, the MPB would not give 1st MLG a \$148,922 financial credit (unserviceable credit value). Instead, 1st MLG would be able to purchase a serviceable tank engine from the MPB for the discounted price of \$371,151 (exchange price), which is a \$148,922 savings from the standard cost of \$520,073 (unit price) for that same engine. Although the replacement engine costs less than if 1st MLG purchased it from another SOS, the MPB's discounted exchange price does not directly increase 1st MLG's total obligation authority. In our research, we omitted the financial value of the MPB's discounted exchange prices and focused only on actual financial credits from the other SOSs that directly increase 1st MLG's spending power.

If, however, 1st MLG submits an M1A1 tank engine (national stock number [NSN] 2385014087048) through the MRP to AKZ (U.S. Army TACOM), AKZ would issue 1st MLG an MRP credit of \$436,303 if the engine were serviceable or \$148,922 if it were unserviceable.

¹⁸ DLA Logistics Information Service publishes FEDLOG as a CD-ROM/DVD that "can be used by engineering, technical research, provisioning, procurement/contracting, supply, cataloging, maintenance, distribution, storage, transportation, quality assurance and disposal personnel to retrieve management, part/reference number, supplier, Commercial and Government Entity (CAGE), freight, Interchangeability and Substitutability (I&S) and characteristics information recorded against National Stock Numbers (NSNs)" (DoD, 2011).

FSC: 2835 NIIN: 014087048 ITEM NAME: ENGINE,GAS TURBINE,NONAIRCRAFT													
ARMY MASTER DATA FILE (AMDF)													
<u>FSC</u>	<u>NOMENCLATURE</u>	<u>ACT</u>	<u>ADDL</u>	<u>SOS</u>	<u>AAC</u>	<u>PSC</u>	<u>ARMY UNIT PRICE</u>	<u>UI</u>	<u>FC</u>	<u>UM</u>	<u>MEAS QTY</u>	<u>EIC</u>	<u>EC</u>
2835	ENGINE,GAS TURBINE,			AKZ	V		\$520,073.00	EA			0		C
<u>SCMC</u>	<u>AEC</u>	<u>MATCAT</u>	<u>LIN</u>	<u>LCC</u>	<u>RICC</u>	<u>ARC</u>	<u>SRC</u>	<u>SCIC</u>	<u>CHC</u>	<u>ICC</u>	<u>SLC</u>		
9 0	3	K 2 1 JE		R	0	X		0	7	8	0		
<u>ARIL</u>	<u>ARIL RIC</u>	<u>DEMIL CODE</u>	<u>ADPE CODE</u>	<u>PMIC</u>	<u>MR</u>	<u>RECOV CODE</u>	<u>ESD</u>	<u>HMIC</u>	<u>CRITL CODE</u>				
R	BA4	F		A	D	D		N	X				
<u>SERVICEABLE CREDIT VALUE</u>	<u>UNSERVICEABLE CREDIT VALUE</u>	<u>EXCHANGE PRICE</u>	<u>SERVICEABLE EP RETURN</u>	<u>DELTA BILL</u>									
\$436,303.00	\$148,922.00	\$371,151.00	\$287,381.00	\$148,922.00									

Figure 5. FEDLOG Screenshot (From DoD, 2011)

E. KEY MRP PARENT SYSTEMS

SASSY and SABRS are the key parent systems that produce data concerning the credit dollar amounts associated with excesses and carcass returns . DSSC and SAS are not within the scope of this thesis.¹⁹

1. Supported Activities Supply System (SASSY)

The Marine Corps utilizes SASSY, an “automated supply management system” (HQMC, 1985b, p. 2-1–17) to accomplish supply accounting for ground equipment. As stated in UM-4400-123 (HQMC, 1985b), “SASSY functions as a centralized record keeper, stock manager, forecaster, and as a central data bank or information point for the using units” (p. 1-1–6).

¹⁹ Neither the DSSC nor the SAS systems will be explained. Simply stated, these are supply distribution systems that are important to the MRP process, but do not support the detailed analysis of credit dollar amounts, which are the focus of this thesis.

a. SASSY–MRP Interaction

SASSY produces a very large number of files and reports, and UM 4400-123 outlines the definitions of the file layouts with the data elements (HQMC, 1985b). SASSY interacts with the MRP in two key areas: (1) The RIP inducts SECREPs into the MRP by submitting FTA/FTE transactions to the SOS via SASSY, and (2) The SOS's FTR response generates a D7P transaction in SASSY that adjusts the RIP's property account.

2. Standard Accounting, Budgeting and Reporting System (SABRS)

SABRS, the Standard Accounting, Budgeting, and Reporting System, is the official financial accounting system for the Marine Corps. MCO 7300.21A (HQMC, 2008) describes SABRS as an automated system that “accounts for and reports on all U.S. Marine Corps funds throughout the life of the appropriation” (p. 1–6).

According to the Marine Corps Financial Management School (2010), “SABRS is a single-source reporting system designed to maximize the sharing of financial data between itself and other automated systems” (p. 2). SABRS interfaces with other automated systems to process financial transactions. The key data field that connects SABRS, SASSY, and MRP is the document number that is generated in SASSY when the RIP inducts a SECREP into the MRP. Although the MRP provides an estimated credit amount (FTZ), the final credit amounts posted in SABRS are the actual amounts received by the RIP, not estimates.

F. 1ST MLG BUDGET PROCESS

1. Financial Chain of Command

As a Major Subordinate Command (MSC) of I MEF, 1st MLG is the Work Center ID (WCI) within the financial management chain of command and reports

directly to the I MEF comptroller on all budget and financial matters. Figure 6 depicts the financial chain of command and flow of appropriated funds from the HQMC to fund managers at the using unit level.

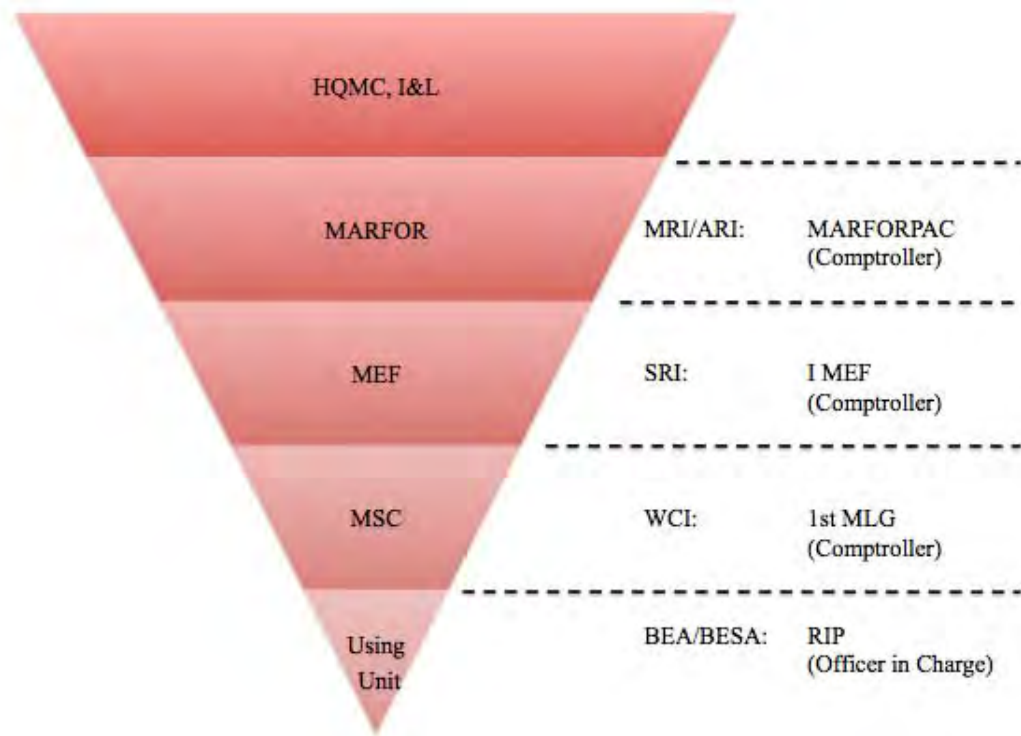


Figure 6. Summary of Financial Management Chain of Command

2. Budgeting

1st MLG uses a requirements-based approach to develop its annual budget request. This approach requires commanders to clearly identify and prioritize all known and anticipated requirements.²⁰ 1st MLG does not provide budget ceilings to subordinate activities, but the overall 1st MLG budget request consolidates prioritized requirements within a restrictive budget ceiling provided by the I MEF.

²⁰ Requirements-based budgeting is a form of zero-based budgeting. Lee, Johnson, & Joyce (2004) described zero-based budgeting as “a form of what-if budgeting” (p. 122) that considers the impact of a program or requirement not being resourced and assumes no base exists.

1st MLG issued its FY2012 budget call on May 16, 2011.²¹ In guidance to his staff and subordinate commanders, the commanding general (CG), 1st MLG, highlighted anticipated resource constraints through FY2012 and reinforced the necessity to be “vigilant stewards of limited resources” (Hudson, 2011, p. 1). Identifying equipment readiness as his top priority, the CG instructed his subordinate commands to clearly “identify and prioritize all requirements ... [in order] to maximize readiness within funding constraints” (Hudson, 2011, p. 1).

G. LITERATURE REVIEW

The review includes three main areas of literature associated with our research: (1) DoD and Marine Corps regulations, directives, and orders; (2) prior academic research and government studies; and (3) other academic resources pertaining to the research methodology and data analysis. In this section, we list and briefly describe the key sources within the three main areas.

1. DoD and USMC Regulations, Directives, and Orders

In our literature review, we found a significant amount of technical literature published by the DoD and the Marine Corps, covering all areas of our research. Specific areas of applicability include those regulations, directives, and orders that require the Marine Corps to utilize the MRP, as well as other key publications needed to manage the program. These resources provide the technical background, system capabilities, and process requirements for supporting materiel, maintenance, and financial management systems. Additional resources in this category provide the background on Marine Corps maintenance, supply, and budget processes necessary to understand the MRP and financial data presented in Chapter IV.

²¹ A budget call routinely includes the commander’s overall budget development guidance, budget formulation guidelines specific to different units and activities, and a standard budget request template.

2. Prior Academic Research and Studies Associated With MRP

The applicability of prior academic research, scholarly articles, and government reports related to the MRP was limited. Those identified in our review focused primarily on the increasing costs and inventory expansion of SECREPs across the DoD or in Services other than the USMC. We reviewed two prior theses in which the MRP either was the subject or was mentioned in relation to other areas of research. Romero and Elliott (2009) offered a brief explanation of the MRP in their analysis of cost drivers for organizational and intermediate-level repair parts across the USMC. Eades (1990) focused specifically on the use of the MRP to manage excess materiel within the Navy. Although they both mentioned credits, neither research project specifically examined MRP credits to determine the presence of historical trends.

3. Acknowledgment of Other Literature

In this review, we found that the Navy, Army, and Air Force all have materiel returns programs because the DoD has mandated their use; we also learned that all the other Services have detailed orders and users manuals for their individual programs. Differences most likely exist between how the individual Services run their programs in accordance with DoD regulations. In addition, through this review, we found that systems similar to the MRP might exist within industry. However, a more detailed and comprehensive literature review of the MRP within all the other services and comparable civilian systems was outside the scope of this research.

This review revealed numerous DoD and service technical publications, orders, directives, and instructions that explain the purpose and functions of the MRP and how the system generates financial credits for users. However, this review only led us to limited instances of prior academic research and government and contractor reports relating directly to the MRP. The documents we identified focused primarily on SECREP cost and inventory management at

the DoD and at the service level. Through this review, we did not find any literature or prior research focused specifically on the effects of MRP credits at the using unit level.

In this chapter, we introduced the key concepts required to develop a fundamental understanding of the MRP system and process, and how that system is used to manage SECREPs within 1st MLG. Additionally, we highlighted how the MRP affects 1st MLG financially with MRP credits. In the following chapters, we explain the process of extracting and analyzing historical MRP and associated SABRS data, review the limitations of that process, and determine whether or not such analysis results in the ability to forecast future credits.

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III. METHODOLOGY AND LIMITATIONS

A. METHODOLOGY

In order to determine whether analysis of historical MRP credits could be used to forecast future credits, we analyzed all MRP and SABRS transactions associated with selected standard document numbers (SDNs) that generate actual MRP credits. In Chapter II, we illustrated how the MRP process uses multiple systems and shows the complexity of the overall process; no single system (MRP, SABRS, or any other system) provides all the data required to conduct a complete analysis.

Our methodology for this research was to acquire the materiel and fiscal data from the 1st MLG RIP and the 1st MLG comptroller's office that would enable identification of systemic patterns or other trends associated with the MRP. We formatted the individual data sets in a way that permitted us to merge them together using the SDN as the connecting data field.

With the materiel and fiscal data formatted and merged, we then analyzed the resulting data set to determine any variation in estimated and actual credits and to identify the SECREPs and SOSs that had the most significant impact on MRP credits at 1st MLG from January 16, 2008, to June 2, 2011.²² We used this analysis to determine if 1st MLG had received more or less credits than actually estimated, first in aggregate and then by the different SOS. From this analysis, we considered how factors such as SOS and National Stock Number (NSN; the actual SECREP inducted into the MRP) affect the time it takes MRP credits to post to 1st MLG's fiscal account. We present this analysis in Chapter IV.

Our methodology identified trends, relationships, and patterns associated with MRP credits at 1st MLG. We used this information to determine whether analysis of historical credits could be used to forecast expected credits at 1st MLG.

²² A detailed explanation of this date range is presented later in this chapter.

1. Required Data

The crux of our analysis was the mining and linking of information contained within two data sets: (1) the MRP Closed Document History File and (2) the SABRS Daily Transaction Report.

a. MRP Closed Document History File

As we discussed in Chapter II, Section D, Materiel Returns Program, the MRP system generates output reports for the RIP. RIP personnel and management use these output reports in various ways to manage the SECREP asset posture and MRP functions. The MRP Closed Document History File is one of these reports, and we obtained this file from the RIP MRP representatives at 1st MLG. This report provides the transaction history of a SDN from the date the RIP inducts a SECREP into the MRP (FTE or FTA transaction) to the date the document is closed in the MRP, and the RIP drops the SECREP from its property records.

The key MRP data fields relevant to our research are SDN; SOS; the document identifier code (DIC) identifying FTA (carcass), FTE (excess), and FTZ (estimated credit amount); and the transaction cycle dates for all transactions. This MRP Closed Document History file depicts the MRP process and transactions presented in the Reparable Issue Point Materiel Returns Program Process Flow diagram (Figure 4), specifically Steps 6, 7, and 11.

In its original form, as depicted in Figure 7, the MRP Closed Document History File is difficult to read and interpret without training and experience on the system.

ACTIVITY: MMFAG8		M A T E R I E L R E T U R N S P R O G R A M										REPORT: A43			
DATE: 2 JUN 2011		CLOSED DOCUMENT HISTORY										PAGE:			
DOCUMENT	NUMBER	DIC	N S N	UI	QTY	PDATE	ST	C	SOS	RSA	DOLLAR VAL	DAY	S FC	PRJ	S S MEC DML
MMFAG8 0004 002E	FTA	4320 01 073 0076	EA	2	10005	TA	F	AKZ	BA4	\$9915.00	005	13	A LV	3AL	1 U 32
	FTR	4320 01 073 0076	EA	2	10005	TA	F	AKZ	BA4	\$9491.00	005	13	A LV	3AL	1 U 32
	FTM			2	10032	TN	F				028	TCN 050084079MIRAMARX			X
	FTZ			2	10034	TN	F			\$12,338.30	032				
	D7P	4320 01 073 0076	EA	2	0005								BA4MRP	A LV	3AL BX
MMFAG8 0004 003E	FTA	6650 01 055 2778	EA	1	10005	TA	F	B14	BR4	\$1083.00	005	13	A LV	3AL	1 7 12
	FTR	6650 01 055 2778	EA	1	10005	TA	F	B14	BR4	\$1049.00	005	13	A LV	3AL	1 7 12
	FTM			1	10032	TN	F			\$681.85	028	TCN 050084078MIRAMARX			X
	FTZ			1	10033	TN	F				032				
	D7P	6650 01 055 2778	EA	1	0005								BR4MRP	A LV	3AL DX
MMFAG8 0004 005E	FTA	2815 01 462 3596	EA	1	10005	TA	F	B16	AQ5	\$15052.00	005	13	A LV	3AL	1 U 22
	FTR	2815 01 462 3596	EA	1	10005	TA	F	B16	AQ5	\$14567.00	005	13	A LV	3AL	1 U 22
	FTZ			1	10190	TN	A			\$9,468.55	188				
	D7P	2815 01 462 3596	EA	1	0005								AQ5MRP	A LV	3AL AX
MMFAG8 0004 006E	FTA	5895 01 407 2627	EA	4	10005	TA	F	B16	BY6	\$2800.00	005	13	A LV	3AL	1 7 42
	FTR	5895 01 407 2627	EA	4	10005	TA	F	B16	BY6	\$2677.00	005	13	A LV	3AL	1 7 42
	FTC			2	10085	NS									
	FTM			4	10041	TN	A				040	TCN 050084245MIRAMARX			X
	FTZ			2	10055	TN	A			\$3,480.10	053				
	D7P	5895 01 407 2627	EA	4	0005								BY6MRP	A LV	3AL DX
MMFAG8 0005 281E	FTA	5975 01 235 1962	EA	58	10006	TA	F	B16	BY6	\$1941.00	006	13	A LV	3AL	1 U 46
	FTR	5975 01 235 1962	EA	58	10006	TA	F	B16	BY6	\$1878.00	006	13	A LV	3AL	1 U 46
	FTM			58	10032	TL	A				028	TCN 050084021MIRAMARX			X
	FTZ			58	10055	TL	A			\$.00	053				
	D7P	5975 01 235 1962	EA	58	0006								BY6MRP	A LV	3AL BX
MMFAG8 0006 001E	FTA	5820 01 411 1421	EA	1	10007	TA	F	B16	BY6	\$3305.00	007	13	A LV	3AL	1 7 42
	FTR	5820 01 411 1421	EA	1	10007	TA	F	B16	BY6	\$3198.00	007	13	A LV	3AL	1 7 42
	FTM			1	10032	TN	A				028	TCN 050084080MIRAMARX			X
	FTZ			1	10056	TN	A			\$2,078.70	054				
	D7P	5820 01 411 1421	EA	1	0007								BY6MRP	A LV	3AL DX

Note. This is a screenshot of raw data provided by the RIP personnel on June 3, 2011.

Figure 7. Screenshot of MRP Closed Document History File

As a text file, this report cannot be sorted or filtered in its current form, making any detailed research or analysis difficult to conduct. Additionally, because the report does not contain data on actual MRP credits posted to SABRS, the MRP Closed Document History File by itself does not convey the whole story of any particular document. In the next section of this chapter, we address the steps used to prepare this data for research.

b. SABRS Daily Transaction Report (DTR)

In Chapter II, Section E, Key MRP Parent Systems, we discussed the Standard Accounting and Budgeting Reporting System (SABRS), which is the single-source financial reporting system that interfaces with other Marine Corps automated systems. The key data field that links SABRS to the MRP is the SDN.

At our request, the 1st MLG comptroller's office pulled a DTR from SABRS showing all MRP-associated transactions for all the RIP budget execution activities (BEAs) and provided us with an Excel spreadsheet with all the data fields that are resident in SABRS. These SABRS data fields identified all the MRP transactions associated with each SDN, including dates for each individual transaction.

The key SABRS data fields that were important to our research were the DIC of FD2, SDN, Routing Identifier Code (RIC), which is the source of supply, Total Transfer Amount, which is the actual credit dollar amount associated with the FD2 transaction, and cycle dates for all transactions. The Excel spreadsheet was easy to read and formatted in a way that allowed for detailed analysis. Figure 8 is a screenshot of the initial SABRS data we received from 1st MLG.

1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
DIC	DIC DESCRIPTION	BEA	BESA	BASIC SYM	SDN	RIC	FUND FUNC	SUBHEAD	TRVL R NAME	SSN	W/D	TOT TRANS AMT	CYCLE DATE	USER ID	NSN	AAC	AAC NAME	FY	SIC	RON		
2074	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30306L02E	FGZ	1A1A	1A1A			M67446	-34,761.09	11/24/2010	IDB	61300133260812R	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2075	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30319L01E	B16	1A1A	1A1A			M67446	-15,559.05	11/30/2010	IDB	598996826503	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2076	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30288L01E	FGZ	1A1A	1A1A			M67446	-41,986.23	11/18/2010	IDB	59850130931602R	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2077	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30277L04	B16	1A1A	1A1A			M67446	-41,944.00	10/20/2010	IDB	5989982484164	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2078	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30298L02E	B16	1A1A	1A1A			M67446	-910.65	11/17/2010	IDB	5998011401278	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2079	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30298L05E	FGZ	1A1A	1A1A			M67446	-96,396.30	11/24/2010	IDB	60300133483842R	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2080	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30307L02E	B16	1A1A	1A1A			M67446	-13,345.80	11/18/2010	IDB	6125014403209	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2081	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30307L01E	B16	1A1A	1A1A			M67446	-13,345.80	11/18/2010	IDB	6125014403209	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2082	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30298L03E	FGZ	1A1A	1A1A			M67446	-25,536.76	11/18/2010	IDB	58200133114332R	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2083	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30298L04E	FGZ	1A1A	1A1A			M67446	-3,555.39	11/18/2010	IDB	59980130855302R	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2084	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30298L06E	FLZ	1A1A	1A1A			M67446	-2,586.49	11/16/2010	IDB	5998011423769RY	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2085	FD2 CR EXCESS MATL RTN (NO CHRG)	GZ	GZ	*1106	MMFAG30277L01E	B16	1A1A	1A1A			M67446	-4,156.75	10/18/2010	IDB	5998014963908	MMFAG3	COMMANDING OFFICER	20112011	DLO			
2086	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80314353E	B14	1A1A	1A1A			M67446	-68,587.35	11/30/2010	IDB	1220015721096	MMFAG8	RIP	20112011	DLO			
2087	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80270112E	B16	1A1A	1A1A			M67446	-1,108.90	10/18/2010	IDB	5998014469636	MMFAG8	RIP	20112011	DLO			
2088	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80308K76E	B16	1A1A	1A1A			M67446	-5,549.05	11/30/2010	IDB	5820012348093	MMFAG8	RIP	20112011	DLO			
2089	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80291110E	AKZ	1A1A	1A1A			M67446	-16,950.70	11/17/2010	IDB	6110014976960	MMFAG8	RIP	20112011	DLO			
2090	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80292138E	B14	1A1A	1A1A			M67446	-15,780.70	11/17/2010	IDB	5975014599483	MMFAG8	RIP	20112011	DLO			
2091	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80271435E	AKZ	1A1A	1A1A			M67446	-2,423.70	11/1/2010	IDB	6140014668167	MMFAG8	RIP	20112011	DLO			
2092	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80264K52E	B16	1A1A	1A1A			M67446	-22,196.20	11/1/2010	IDB	5820013652725	MMFAG8	RIP	20112011	DLO			
2093	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80293367E	AKZ	1A1A	1A1A			M67446	-1,066.90	11/1/2010	IDB	4730011301980	MMFAG8	RIP	20112011	DLO			
2094	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80293351E	AKZ	1A1A	1A1A			M67446	-15,322.45	11/1/2010	IDB	5963014746208	MMFAG8	RIP	20112011	DLO			
2095	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80306110F	R1R	1A1A	1A1A			M67446	-10,081.50	11/18/2010	IDB	5980014804875	MMFAG8	RIP	20112011	DLO			
2096	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80069E561	AKZ	1A1A	1A1A			M67446	-10,525.00	11/18/2010	IDB	2520011441528	MMFAG8	RIP	20112011	DLO			
2097	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80271950E	B16	1A1A	1A1A			M67446	-842.40	11/18/2010	IDB	5998014210800	MMFAG8	RIP	20112011	DLO			
2098	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80307330E	B16	1A1A	1A1A			M67446	-449.80	11/18/2010	IDB	5998014108974	MMFAG8	RIP	20112011	DLO			
2099	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80285113E	B16	1A1A	1A1A			M67446	-940.55	10/27/2010	IDB	5998014108975	MMFAG8	RIP	20112011	DLO			
2100	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80062024E	AKZ	1A1A	1A1A			M67446	-121,007.90	11/24/2010	IDB	2520013259634	MMFAG8	RIP	20112011	DLO			
2101	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80291K01E	B16	1A1A	1A1A			M67446	-5,549.05	11/24/2010	IDB	5820014441219	MMFAG8	RIP	20112011	DLO			
2102	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80281K51E	B16	1A1A	1A1A			M67446	-5,549.05	11/24/2010	IDB	5820014441219	MMFAG8	RIP	20112011	DLO			
2103	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80195113E	AKZ	1A1A	1A1A			M67446	-7,336.90	11/24/2010	IDB	2815014617078	MMFAG8	RIP	20112011	DLO			
2104	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80285117E	AKZ	1A1A	1A1A			M67446	-4,672.20	11/24/2010	IDB	4210014919279	MMFAG8	RIP	20112011	DLO			
2105	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80292133E	B14	1A1A	1A1A			M67446	-15,780.70	11/17/2010	IDB	5975014599483	MMFAG8	RIP	20112011	DLO			
2106	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80263K81E	B16	1A1A	1A1A			M67446	-5,549.05	11/10/2010	IDB	5820013652725	MMFAG8	RIP	20112011	DLO			
2107	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80263K83E	B16	1A1A	1A1A			M67446	-5,549.05	11/10/2010	IDB	5820013652725	MMFAG8	RIP	20112011	DLO			
2108	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80291103E	AKZ	1A1A	1A1A			M67446	-16,950.70	11/17/2010	IDB	6110014976960	MMFAG8	RIP	20112011	DLO			
2109	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80291106E	AKZ	1A1A	1A1A			M67446	-16,950.70	11/17/2010	IDB	6110014976960	MMFAG8	RIP	20112011	DLO			
2110	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80292345E	B16	1A1A	1A1A			M67446	-1,596.40	11/1/2010	IDB	5985014498532	MMFAG8	RIP	20112011	DLO			
2111	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80251K71E	B16	1A1A	1A1A			M67446	-5,549.05	10/18/2010	IDB	5820013652725	MMFAG8	RIP	20112011	DLO			
2112	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80251K73E	B16	1A1A	1A1A			M67446	-5,549.05	10/18/2010	IDB	5820013652725	MMFAG8	RIP	20112011	DLO			
2113	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80278502E	B16	1A1A	1A1A			M67446	-7,230.60	10/18/2010	IDB	5985014210093	MMFAG8	RIP	20112011	DLO			
2114	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80278500E	B16	1A1A	1A1A			M67446	-7,230.60	10/18/2010	IDB	5985011888819	MMFAG8	RIP	20112011	DLO			
2115	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80272104E	B16	1A1A	1A1A			M67446	-7,569.90	10/18/2010	IDB	5975012351962	MMFAG8	RIP	20112011	DLO			
2116	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80251914E	B16	1A1A	1A1A			M67446	-437.45	10/18/2010	IDB	7025014969879	MMFAG8	RIP	20112011	DLO			
2117	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80229336E	AKZ	1A1A	1A1A			M67446	-2,174.90	11/1/2010	IDB	2815014900796	MMFAG8	RIP	20112011	DLO			
2118	FD2 CR EXCESS MATL RTN (NO CHRG)	GY	GY	*1106	MMFAG80271410F	AKZ	1A1A	1A1A			M67446	-3,058.25	11/1/2010	IDB	6110012859848	MMFAG8	RIP	20112011	DLO			

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FD08 TO FY11 SABRS MRP DATA

Note. This is a screenshot of raw data provided by the 1st MLG comptroller on June 3, 2011.

Figure 8. Screenshot of SABRS Daily Transaction Report for MRP Data in Excel

After we obtained both the MRP Closed Document History File and the SABRS Daily Transaction report data, we determined that the data needed to be formatted in a way that allowed us to compare them. Specifically, we needed to merge the two data sets using the SDN as the common data field. In the Data Preparation section, we address the steps we took to prepare the data for detailed analysis.

2. Data Preparation

The initial raw materiel and financial data that we obtained from 1st MLG were not formatted in a manner that enabled the detailed analysis required for our research. In the following sections we explain the actions we took to clean and format the data for analysis.

a. Preparing the MRP Closed Document History File

The original MRP Closed Document History File that the 1st MLG RIP provided to us was a raw text file. We first imported this text file into Microsoft Access where we cleaned and formatted the data before exporting the document as a Microsoft Excel spreadsheet as shown in Figure 9.

which in this case was January 20. This process may have inflated some lead-times to a small degree, but by performing this operation, we were then able to associate the total estimated credit amount with each individual SDN.

Finally, all transactions associated with a given SDN were listed in the same row of the spreadsheet. In its final clean format, our MRP Closed Document History File Master showed the initial MRP transaction from the 1st MLG RIP (FTA or FTE), the SOS response with estimated credit amount (FTZ), and all associated data fields for each transaction on a single row by SDN. Figure 10 is an example of our MRP Closed Document History File Master file.

MRP DATA														
SDN	DIC	NSN	QTY	FTE/A JULIAN DATE	COND CODE	SOS	FEDLOG U/P	DIC	QTY	FTZ JULIAN DATE	STATUS	COND CODE	FTZ AMT	
MMFAG30008L99E	FTA	5985015212206	1	10018	F	B16	\$5092.00	FTZ	1	10050	TN	A	\$ 3,203	
MMFAG30014100E	FTA	5998011418997	1	10015	F	B16	\$2452.44	FTZ	1	10053	TN	A	\$ 1,584.3	
MMFAG30025001E	FTA	6625011809592	1	10026	F	FLZ	\$5970.60	FTZ	1	10041	TN	F	\$ 4,029.0	
MMFAG30025002E	FTA	5960013268986	1	10026	F	FLZ	\$14404.77	FTZ	1	10050	TN	F	\$ 6,874.0	
MMFAG30025EX02	FTE	5998015607732	1	10026	A	N35	\$11298.00	FTZ	1	10060	TN	A	\$ 3,432.0	
MMFAG30025EX03	FTE	5998015663138	1	10026	A	B16	\$44712.00	FTZ	1	10053	TN	A	\$ 36,800.0	
MMFAG30035001E	FTA	5998011092109	1	10036	F	B16	\$5983.00	FTZ	1	10053	TN	A	\$ 3,719.3	
MMFAG30036L30E	FTA	5985011601106	1	10039	F	FLZ	\$763.98	FTZ	1	10068	TN	F	\$ 245.0	
MMFAG30036L31E	FTA	5960013268986	1	10039	F	FLZ	\$14404.77	FTZ	1	10067	TN	F	\$ 6,874.0	
MMFAG30036L33E	FTA	5895015306014	3	10039	F	B16	\$4766.00	FTZ	3	10055	TN	A	\$ 8,993.4	
MMFAG30050001E	FTA	6030013348384	1	10053	F	FGZ	\$148302.00	FTZ	1	10095	TN	F	\$ 96,951.0	
MMFAG30050003E	FTA	6130013326081	1	10053	F	FGZ	\$53478.60	FTZ	1	10097	TN	F	\$ 32,722.0	
MMFAG30050EX02	FTE	5895011096401	2	10053	A	B16	\$24354.00	FTZ	2	10123	TN	A	\$ 33,430.0	
MMFAG30050EX05	FTE	5985011011980	1	10053	A	B16	\$40674.00	FTZ	1	10123	TN	A	\$ 32,397.0	
MMFAG30050EX06	FTE	5895014578318	1	10053	A	B16	\$38384.00	FTZ	1	10123	TN	A	\$ 27,869.0	
MMFAG30050EX07	FTE	6625015214690	1	10053	A	B16	\$36833.00	FTZ	1	10123	TN	A	\$ 29,338.0	
MMFAG30050EX10	FTE	5998014643322	1	10053	A	MPB	\$10985.34	FTZ	1	10109	TN	A	\$ 10,566.0	
MMFAG30050EX13	FTE	5996013455180	1	10053	A	B16	\$29743.00	FTZ	1	10088	TN	A	\$ 594.0	
MMFAG30050EX15	FTE	6110014964264	1	10053	A	B16	\$13129.00	FTZ	1	10167	TN	A	\$ 10,333.0	
MMFAG30050EX17	FTE	5996015046695	2	10053	A	B16	\$11838.00	FTZ	1	10179	TN	A	\$ 9,429.0	
MMFAG30050EX20	FTE	1670015379821	1	10053	A	B16	\$661.00	FTZ	1	10179	TN	A	\$ 544.0	
MMFAG30050EX22	FTE	5965014643372	1	10053	A	SMS	\$715.22	FTZ	1	10123	TN	A	\$ 643.8	
MMFAG30050EX25	FTE	5915014864068	1	10053	A	B16	\$1262.00	FTZ	1	10085	TN	A	\$ 1,038.0	
MMFAG30050EX27	FTE	5915014398404	1	10053	A	B16	\$1324.00	FTZ	1	10155	TN	A	\$ 1,054.0	
MMFAG30050EX30	FTE	5965011423740	1	10053	A	B16	\$23735.54	FTZ	1	10123	TN	A	\$ 13,603.0	

Figure 10. Screenshot of Formatted MRP Data Master File in Excel

b. Preparing the SABRS MRP Transactions

Unlike the MRP Closed Document History File, the SABRS Daily Transaction Report provided by the 1st MLG comptroller's office was already formatted as a Microsoft Excel spreadsheet. Formatting and cleaning the SABRS

data was limited to isolating the FD2 actual credit transactions with their associated data fields. Additionally, we identified several SDNs with more than one FD2 actual credit transaction. In these instances, we summed all the FD2 actual credit amounts associated with each SDN and consolidated them under the latest FD2 cycle date. If an SDN had an FD2 for a \$100 post on January 1, 2010, and a second FD2 post for \$50 on February 1, 2010, we combined the two actual credits to show a total FD2 actual credit amount of \$150 on February 1, 2010. As with consolidating the FTZ transactions, this process may have inflated slightly some lead-times; however, it allowed us to associate the total actual credit amount with each individual SDN.

In its final, clean format, as depicted in Figure 11, the SABRS Master Daily Transaction Report contained each SDN's FD2 actual credit amount and all associated data fields for that transaction on a single row.

	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	SABRS DATA											
2	SDN	DIC	BEA	BESA	RIC	FD2 AMT	FD2 CYCLE DATE	FD2 JULIAN DATE	NSN	AAC	FY	
3	MMFAG30008L99E	FD2	GZ	GZ	B16	\$ 3,203	03/04/10	10063	5985015212206	MMFAG3	20102010	
4	MMFAG30014100E	FD2	GY	GY	B16	\$ 1,584	02/24/10	10055	5998011418997	MMFAG3	20102010	
5	MMFAG30025001E	FD2	GY	GY	FLZ	\$ 3,857	02/19/10	10050	6625011809592RY	MMFAG3	20102010	
6	MMFAG30025002E	FD2	GY	GY	FLZ	\$ 9,363	02/26/10	10057	5960013268986RY	MMFAG3	20102010	
7	MMFAG30025EX02	FD2	GY	GY	N35	\$ 3,432	03/05/10	10064	5998015607732	MMFAG3	20102010	
8	MMFAG30025EX03	FD2	GY	GY	B16	\$ 36,800	02/24/10	10055	5998015663138	MMFAG3	20102010	
9	MMFAG30035001E	FD2	GY	GY	B16	\$ 3,719	02/24/10	10055	5998011092109	MMFAG3	20102010	
10	MMFAG30036L30E	FD2	GZ	GZ	FLZ	\$ 494	04/09/10	10099	5985011601106	MMFAG3	20102010	
11	MMFAG30036L31E	FD2	GZ	GZ	FLZ	\$ 9,363	03/29/10	10088	5960013268986RY	MMFAG3	20102010	
12	MMFAG30036L33E	FD2	GZ	GZ	B16	\$ 17,987	03/29/10	10088	5895015306014	MMFAG3	20102010	
13	MMFAG30050001E	FD2	GY	GY	FGZ	\$ 95,803	04/19/10	10109	6030013348384ZR	MMFAG3	20102010	
14	MMFAG30050003E	FD2	GY	GY	FGZ	\$ 34,547	04/19/10	10109	6130013326081ZR	MMFAG3	20102010	
15	MMFAG30050EX02	FD2	GY	GY	B16	\$ 33,430	05/06/10	10126	5895011096401	MMFAG3	20102010	
16	MMFAG30050EX05	FD2	GY	GY	B16	\$ 32,397	05/06/10	10126	5985011011980	MMFAG3	20102010	
17	MMFAG30050EX06	FD2	GY	GY	B16	\$ 27,869	05/06/10	10126	5895014578318	MMFAG3	20102010	
18	MMFAG30050EX07	FD2	GY	GY	B16	\$ 29,338	05/06/10	10126	6625015214690	MMFAG3	20102010	
19	MMFAG30050EX10	FD2	GZ	GZ	SDA	\$ 10,566	04/27/10	10117	5998014643322	MMFAG3	20102010	
20	MMFAG30050EX13	FD2	GY	GY	B16	\$ 594	04/04/10	10094	5895010423421	MMFAG3	20102010	
21	MMFAG30050EX15	FD2	GZ	GZ	B16	\$ 10,333	06/21/10	10172	6110014964264	MMFAG3	20102010	
22	MMFAG30050EX17	FD2	GZ	GZ	B16	\$ 9,429	07/04/10	10185	5996015046695	MMFAG3	20102010	
23	MMFAG30050EX20	FD2	GZ	GZ	B16	\$ 544	07/04/10	10185	1670015379821	MMFAG3	20102010	
24	MMFAG30050EX22	FD2	GZ	GZ	SMS	\$ 610	05/11/10	10131	5965014643372	MMFAG3	20102010	
25	MMFAG30050EX25	FD2	GY	GY	B16	\$ 1,038	03/30/10	10089	5915014864068	MMFAG3	20102010	
26	MMFAG30050EX27	FD2	GZ	GZ	B16	\$ 1,054	06/14/10	10165	5915014398404	MMFAG3	20102010	
27	MMFAG30050EX29	FD2	GY	GY	B16	\$ 13,603	05/06/10	10126	5985011011980	MMFAG3	20102010	

Figure 11. Screenshot of Formatted SABRS Master File in Excel

3. Master Data File for Analysis

With both the MRP and SABRS master files formatted as described previously, they were ready for us to merge into a single spreadsheet with one SDN on each row containing all of the MRP and SABRS transactions associated with that particular SDN. Merging the MRP and SABRS data in this manner enabled more efficient analysis of each SDN through its entire life cycle. A reader could easily follow any SDN from the RIP's initial induction of the item to the MRP with an FTE/FTA, to the SOS's FTZ response with the estimated credit amount, and, finally, to the FD2's actual credit posting to the RIP's financial account in SABRS. In addition, the final merged master spreadsheet contained amplifying data fields for each SDN, including NSN, transaction cycle dates, condition code, SOS/RIC, and various financial accounting fields as shown in Figure 12.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	MRP DATA												SABRS DATA							
2	SDN	DIC	NSN	QTY	FTE/A JULIAN DATE	COND CODE	SOS	FEDLOG U/P	DIC	QTY	FTZ JULIAN DATE	STATUS	FTZ AMT	DIC	BEA	RIC	FD2 AMT	FD2 JULIAN DATE	AAC	
3	MMFAG30008L99E	FTA	5985015212206	1	10018	F	B16	\$5092.00	FTZ	1	10050	TN	\$ 3,203	FD2	GZ	B16	\$ 3,203	10063	MMFAG3	
4	MMFAG30014100E	FTA	5998011418997	1	10015	F	B16	\$2452.44	FTZ	1	10053	TN	\$ 1,584.3	FD2	GY	B16	\$ 1,584	10055	MMFAG3	
5	MMFAG30025001E	FTA	6625011809592	1	10026	F	FLZ	\$5970.60	FTZ	1	10041	TN	\$ 4,029.0	FD2	GY	FLZ	\$ 3,857	10050	MMFAG3	
6	MMFAG30025002E	FTA	5960013268986	1	10026	F	FLZ	\$14404.77	FTZ	1	10050	TN	\$ 6,874.0	FD2	GY	FLZ	\$ 9,363	10057	MMFAG3	
7	MMFAG30025EX02	FTE	5998015607732	1	10026	A	N35	\$11298.00	FTZ	1	10060	TN	\$ 3,432.0	FD2	GY	N35	\$ 3,432	10064	MMFAG3	
8	MMFAG30025EX03	FTE	5998015663138	1	10026	A	B16	\$44712.00	FTZ	1	10053	TN	\$ 36,800.0	FD2	GY	B16	\$ 36,800	10055	MMFAG3	
9	MMFAG30035001E	FTA	5998011092109	1	10036	F	B16	\$5983.00	FTZ	1	10053	TN	\$ 3,719.3	FD2	GY	B16	\$ 3,719	10055	MMFAG3	
10	MMFAG30036L30E	FTA	5985011601106	1	10039	F	FLZ	\$763.98	FTZ	1	10068	TN	\$ 245.0	FD2	GZ	FLZ	\$ 494	10099	MMFAG3	
11	MMFAG30036L31E	FTA	5960013268986	1	10039	F	FLZ	\$14404.77	FTZ	1	10067	TN	\$ 6,874.0	FD2	GZ	FLZ	\$ 9,363	10088	MMFAG3	
12	MMFAG30036L33E	FTA	5895015306014	3	10039	F	B16	\$4766.00	FTZ	3	10055	TN	\$ 8,993.4	FD2	GZ	B16	\$ 17,987	10088	MMFAG3	
13	MMFAG30050001E	FTA	6030013348384	1	10053	F	FGZ	\$148302.00	FTZ	1	10095	TN	\$ 96,951.0	FD2	GY	FGZ	\$ 95,803	10109	MMFAG3	
14	MMFAG30050003E	FTA	6130013326081	1	10053	F	FGZ	\$53478.60	FTZ	1	10097	TN	\$ 32,722.0	FD2	GY	FGZ	\$ 34,547	10109	MMFAG3	
15	MMFAG30050EX02	FTE	5895011096401	2	10053	A	B16	\$24354.00	FTZ	2	10123	TN	\$ 33,430.0	FD2	GY	B16	\$ 33,430	10126	MMFAG3	
16	MMFAG30050EX05	FTE	5985011011980	1	10053	A	B16	\$40674.00	FTZ	1	10123	TN	\$ 32,397.0	FD2	GY	B16	\$ 32,397	10126	MMFAG3	
17	MMFAG30050EX06	FTE	5895014578318	1	10053	A	B16	\$38384.00	FTZ	1	10123	TN	\$ 27,869.0	FD2	GY	B16	\$ 27,869	10126	MMFAG3	
18	MMFAG30050EX07	FTE	6625015214690	1	10053	A	B16	\$36833.00	FTZ	1	10123	TN	\$ 29,338.0	FD2	GY	B16	\$ 29,338	10126	MMFAG3	
19	MMFAG30050EX10	FTE	5998014643322	1	10053	A	MPB	\$10985.34	FTZ	1	10109	TN	\$ 10,566.0	FD2	GZ	SDA	\$ 10,566	10117	MMFAG3	
20	MMFAG30050EX13	FTE	5996013455180	1	10053	A	B16	\$29743.00	FTZ	1	10088	TN	\$ 594.0	FD2	GY	B16	\$ 594	10094	MMFAG3	
21	MMFAG30050EX15	FTE	6110014964264	1	10053	A	B16	\$13129.00	FTZ	1	10167	TN	\$ 10,333.0	FD2	GZ	B16	\$ 10,333	10172	MMFAG3	
22	MMFAG30050EX17	FTE	5996015046695	2	10053	A	B16	\$11838.00	FTZ	1	10179	TN	\$ 9,429.0	FD2	GZ	B16	\$ 9,429	10185	MMFAG3	
23	MMFAG30050EX20	FTE	1670015379821	1	10053	A	B16	\$661.00	FTZ	1	10179	TN	\$ 544.0	FD2	GZ	B16	\$ 544	10185	MMFAG3	
24	MMFAG30050EX22	FTE	5965014643372	1	10053	A	SMS	\$715.22	FTZ	1	10123	TN	\$ 643.8	FD2	GZ	SMS	\$ 610	10131	MMFAG3	
25	MMFAG30050EX25	FTE	5915014864068	1	10053	A	B16	\$1262.00	FTZ	1	10085	TN	\$ 1,038.0	FD2	GY	B16	\$ 1,038	10089	MMFAG3	
26	MMFAG30050EX27	FTE	5915014398404	1	10053	A	B16	\$1324.00	FTZ	1	10155	TN	\$ 1,054.0	FD2	GZ	B16	\$ 1,054	10165	MMFAG3	
27	MMFAG30050EX29	FTE	5895011423749	1	10053	A	B16	\$21725.51	FTZ	1	10123	TN	\$ 13,683.0	FD2	GY	B16	\$ 13,683	10126	MMFAG3	
28	MMFAG30050EX30	FTE	6125014403209	1	10053	A	B16	\$20532.00	FTZ	1	10085	TN	\$ 16,160.0	FD2	GY	B16	\$ 16,160	10089	MMFAG3	
29	MMFAG30050EX33	FTE	5998013798845	1	10053	A	FLZ	\$17675.54	FTZ	1	10119	TN	\$ 13,766.0	FD2	GY	FLZ	\$ 13,766	10126	MMFAG3	
30	MMFAG30050EX35	FTE	5996015212193	1	10053	A	B16	\$17127.00	FTZ	1	10088	TN	\$ 9,249.0	FD2	GY	B16	\$ 9,249	10094	MMFAG3	

Figure 12. Screenshot of Merged Master Data for Analysis

B. LIMITATIONS

The primary limitation of our research was the data available for analysis. In particular, the MRP Closed Document History File dictated the range of data that we could analyze. In this section, we identify the date range limitation and the challenges caused by date gaps between the MRP and SABRS data that prevented a more comprehensive analysis.

1. Data Date Range

We focused our analysis on the MRP activity that occurred at 1st MLG from January 16, 2008, to June 2, 2011. We determined this range based on the MRP and SABRS data provided by 1st MLG. The SABRS Daily Transaction Report history goes back five years (L. Bell, personal communication, August 9, 2011), while the MRP Closed Document History File goes back only two years (J. Milazzo, personal communication, July 26, 2011), making the unavailability of earlier data in the MRP system archive the primary factor in determining our date range. After we had cleaned, formatted, and merged the data, they showed the entire life of each SDN, from the time it was opened to the time it was closed (i.e., a cradle-to-grave history for each SDN within this date range). Throughout the process of cleaning and formatting the data, however, we repeatedly encountered significant gaps between the MRP and SABRS transactions.

2. Data Gaps Between MRP AND SABRS

We identified two main data gaps between the MRP and SABRS transactions provided by 1st MLG: (1) SDNs with FD2 (actual credit) transactions in SABRS with no associated MRP transactions and (2) SDNs with MRP FTZ (notification of estimated credit) transactions with no associated SABRS transactions. Both of these gaps prevented us from adequately analyzing these SDNs with the method explained previously.

a. *FD2 Actual Credits in SABRS With No Associated MRP Data*

The initial gap we identified included all the documents that had FD2 credits in SABRS, but did not have a corresponding MRP transaction (FTA/E or FTZ). This disparity resulted directly from the limitations in the MRP Closed Document History File archive. If it took a SDN more than two years from the time the RIP initiated it in the MRP for the FD2 credit to post in SABRS, the SDN's corresponding MRP transaction would no longer be included in the MRP Closed Document History file. Therefore, we had 702 SABRS FD2 credit transactions, totaling \$7,430,994 in credits, whose associated MRP transactions pre-dated the available MRP data and could not be used in our analysis. We overcame this limitation by omitting all SABRS FD2 transactions whose corresponding MRP transactions pre-dated our data. After omitting those SDNs, we continued to find gaps between MRP and SABRS transaction data.

b. *FTZ Estimated Credits in MRP With No Associated SABRS Data*

Next, we identified documents in the MRP Closed Document History File with FTZ transactions that did not have a corresponding FD2 credit transaction in SABRS. In total, we identified 706 SDNs in this category. Through further analysis, we determined that out of that 706, only 130 SDNs had an FTZ with a TN status code, indicating the SOS would provide the MRP credit. The remaining 576 FTZ transactions all had status codes indicating that the SOS would not issue 1st MLG an MRP credit for these transactions for one of various reasons.²³ As we did with the SDNs that had FD2 transactions but no MRP transactions, we omitted the SDNs that were still pending FD2s in SABRS.

²³ Reasons for the SOS not issuing credit included the following: TL—item was other than authorized for return (x 333); TM—item condition received was less than reported (x 25); TP—item not received by SOS within prescribed timeframe (x 11); TQ—non-creditable return as indicated in FTR response (x 206); TV—non-creditable return authorization cancelled due to item not being received by SOS in prescribed time frame (x 1)

3. Data Date Range and Gaps

Our research and analysis were dictated by two factors—the date range of the available MRP and SABRS data, and whether or not SDNs within that date range had corresponding MRP and SABRS transactions. Rather than just use the overlapping date ranges in the MRP and SABRS data to conduct analysis, we focused our research on MRP documents at 1st MLG that had a complete cradle-to-grave history between January 16, 2008, and June 2, 2011. Only those MRP documents that had been initiated at the RIP, had been processed by the SOS, and had received a credit in SABRS during that period were included in our analysis, which resulted in 4,282 SDNs. We omitted from our research any documents that the RIP initiated during this time period, but that had not received a credit by June 2, 2011 (706 SDNs), and those that received a credit during this time period but that were initiated prior to January 16, 2008 (702 SDNs). As Figure 13 visually depicts, our analysis only includes those SDNs with a complete cradle-to-grave document history and excludes all others.

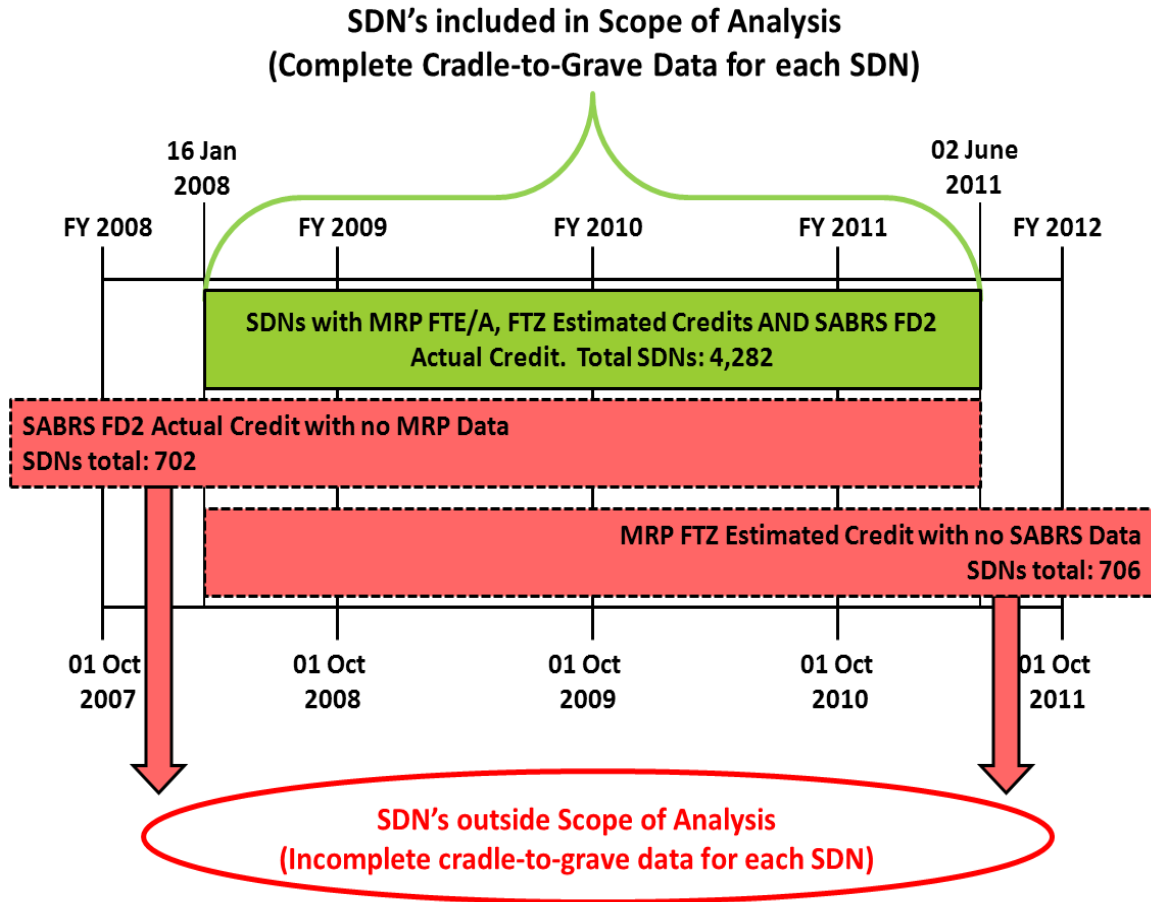


Figure 13. Scope of Analysis

In Chapter III, we provided an overview of the data we required in order to analyze historical MRP credits at 1st MLG, described how we processed that data into a usable format, and explained the limitations and challenges we encountered during that process. Additionally, we highlighted how those limitations and challenges drove the composition of the final data set we analyze in Chapter IV.

IV. DATA ANALYSIS AND PRESENTATION

In our analysis of historical MRP and SABRS data, we focused on two main areas: (a) MRP credits and (b) MRP credit lead-times. These were the most relevant areas to analyze because the credits have a large effect on 1st MLG's budget, as we discussed in Chapter I, and the lead-times associated with these credits affect the ongoing budgeting process within the 1st MLG comptroller's office. Additionally, we determined that a thorough understanding of the trends associated with MRP credits and credit lead-times was required in order to determine whether an analysis of historical MRP credits can be used to forecast expected credits.

A. ANALYSIS OF MATERIEL RETURNS PROGRAM (MRP) CREDITS

Our research focused on the actual MRP credits 1st MLG received in SABRS and the estimated credits provided by the SOSs in the MRP. In this section, we show which SOSs account for the largest amounts of actual MRP credits, the percentages of ground common/low density and excess/carcass, a comparison between total actual and estimated credit amounts, and a breakdown of the resulting underestimated and overestimated credits.

1. Pareto Analysis of MRP Actual Credits

During our analysis of the MRP activity at 1st MLG from January 16, 2008, to June 2, 2011, we identified 11 SOSs that provided actual credits to 1st MLG. In order to determine which SOSs produced the most activity in relation to credits, we conducted a Pareto analysis of actual MRP credits. Pareto analysis is a statistical technique used to select a limited number of tasks that produce a significant overall effect. The Pareto principle—"the few having the greatest importance and the many having little importance" (Jacobs, Chase, & Aquilano, 2009, p. 569)—uses a logic defined in the 19th century. The numbers usually associated with a Pareto analysis are as follows: the large majority of effects, 80%, are produced by a few tasks, 20%. For the purpose of our research, we

used a Pareto analysis, as shown in Figure 14 and Table 4, to show the SOSs that generated the greatest number of MRP actual credits in SABRS from January 16, 2008, to June 2, 2011. As addressed in Chapter III, these credit amounts come only from SDNs with full cradle-to-grave data. This Pareto analysis included all ground common and low density SECREPS, and included all carcass (FTA) and excess (FTE) SECREPS.

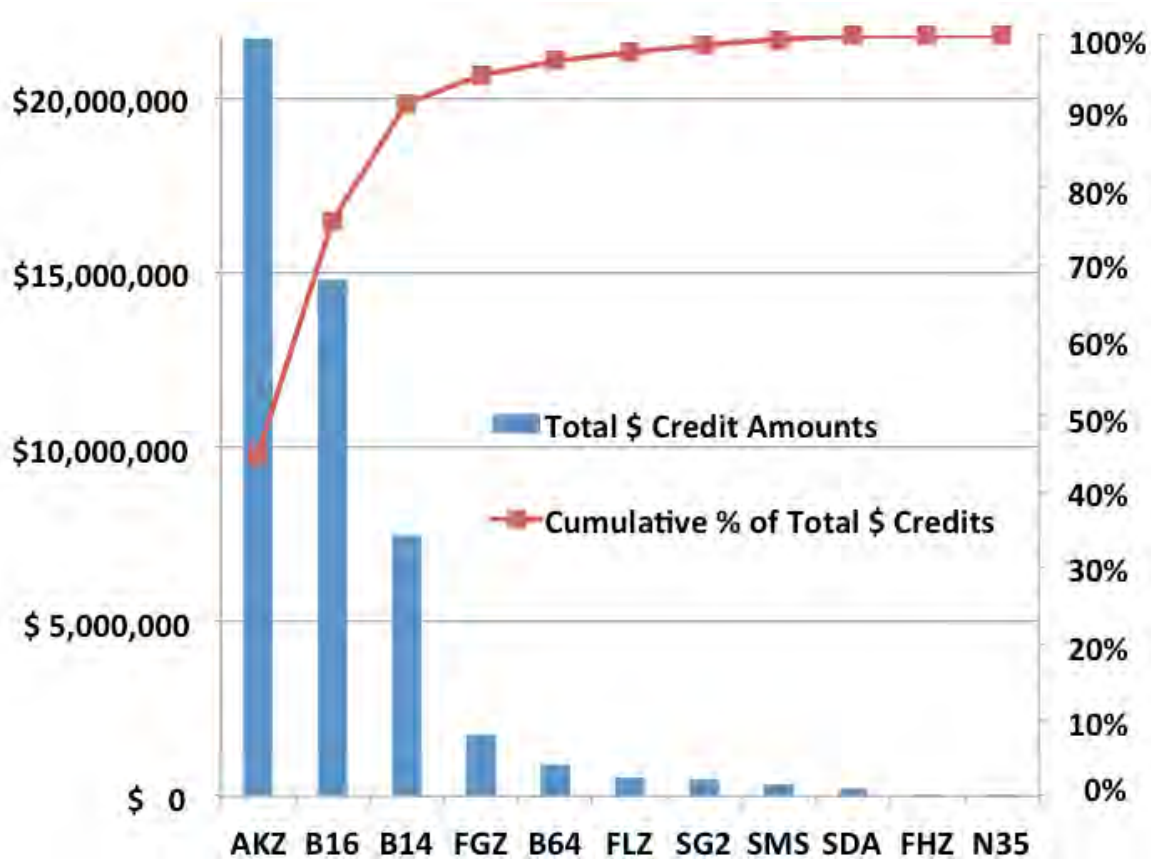


Figure 14. Pareto Analysis of Actual MRP Credits From Sources of Supply (SOS)

Table 4. Data for Pareto Analysis in Figure 14

SOS	Total \$ Credit Amounts	Cumulative % of Total \$ Credits	% of Total \$ Credits
AKZ	\$21,712,033	44.97%	44.97%
B16	\$14,806,085	75.64%	30.67%
B14	\$7,471,135	91.12%	15.48%
FGZ	\$1,762,837	94.77%	3.65%
B64	\$910,001	96.65%	1.88%
FLZ	\$541,229	97.78%	1.12%
SG2	\$477,706	98.77%	0.99%
SMS	\$349,177	99.49%	0.72%
SDA	\$225,602	99.96%	0.47%
FHZ	\$16,695	99.99%	0.03%
N35	\$4,620	100.00%	0.01%
Total	\$48,277,120		

Our analysis showed that AKZ (TACOM, Warren, MI) and B16 (CECOM, Monmouth, NJ) provided 75.64% of the MRP actual credits, totaling \$36,518,118. By adding in B14 (ACALA, Rock Island, IL), we calculated that these top three SOSs provided 91.12% of the MRP actual credits, totaling \$43,989,235. All eight of the remaining SOSs made up only 8.88% of the MRP actual credits, totaling \$4,287,867.

2. **Ground Common (GC) VS. Low Density (LD) and Excess (FTE) vs. Carcass (FTA)**

We presented the definitions of ground common, low density, excess (FTE), and carcass (FTA) SECREPs in Chapter II. During our analysis, we identified the differences between ground common and low density, and excess and carcass SECREPs. In the next section, we provide a more detailed analysis of these differences and an explanation of how we addressed them in our overall analysis.

a. **Ground Common (GC) vs. Low Density (LD)**

We defined ground common (MMFAG8) and low density (MMFAG3) SECREPs in Chapter II. The difference between the two accounts stems from the type of principle end item (PEI) that requires the SECREP and the activity authorized to perform maintenance on the SECREP. Both types of

SECREPs generate actual credits when inducted into the MRP. Figure 15 shows the actual credit amounts and percentages of all the ground common and low density SECREPs that we analyzed.

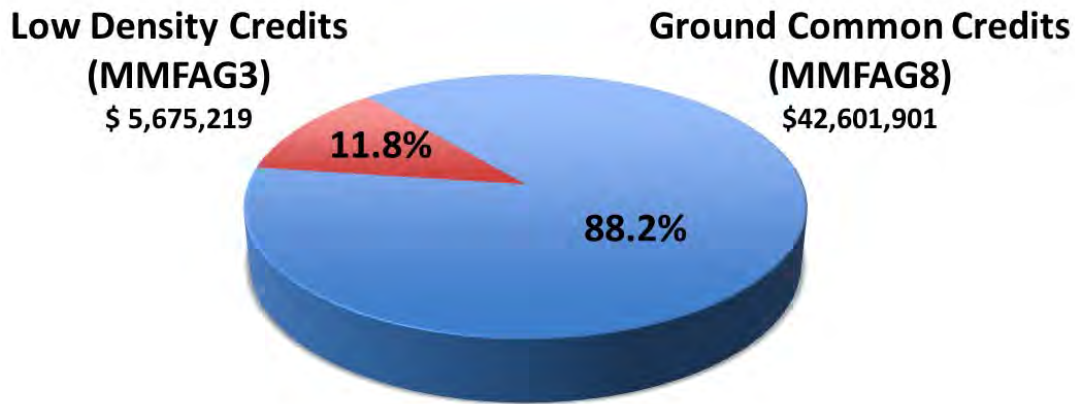


Figure 15. Low Density (MMFAG3) and Ground Common (MMFAG8) Dollar Amounts and Percentages

Ground common (MMFAG8) MRP actual credits made up 88.2% of all the actual credits that 1st MLG received during the SDN date range we analyzed, totaling \$42,601,901. Low-density (MMFAG3) MRP actual credits made up 11.8% of all the actual credits, totaling \$5,675,219. We assumed that this was a good representation of the overall ground common and low-density activity over time.

It was outside the scope of our research to conduct a detailed analysis of these two categories of SECREPs individually. We conducted all of our analysis on all of the SDNs in our date range, making no distinction between ground common (MMFAG8) and low density (MMFAG3) anywhere else in this thesis.

b. Excess (FTE) vs. Carcass (FTA)

MRP classifies SECREPs in two categories, excess (FTE) and carcass (FTA). Excess items can be serviceable or unserviceable and have no requirement for replacement. Carcass items are unserviceable and require

replacement to fill a customer requirement or replenish the RIP's authorized stockage levels. Both types of SECREPs generate actual credits when they are inducted into the MRP. Figure 16 shows the actual credit amounts 1st MLG received between January 16, 2008 and June 2, 2011 and the percentages of all SECREPs that we analyzed from.

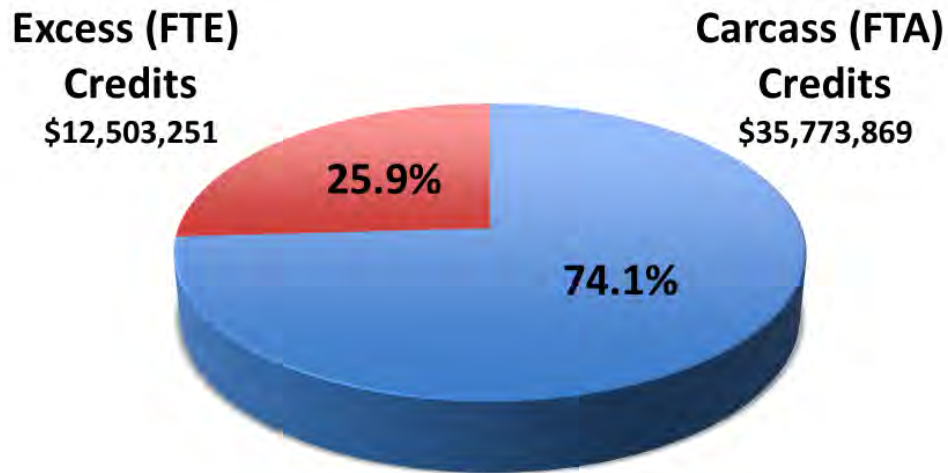


Figure 16. Excess (FTE) and Carcass (FTA) Dollar Amounts and Percentages

Carcass (FTA) MRP actual credits made up 74.1% of all the actual credits that 1st MLG received during the SDN date range we analyzed. Excess (FTE) MRP actual credits made up 25.9% of all the actual credits. Our original assumption was that this was a good representation of the overall amount of carcass and excess activity over time. However, as depicted in Figure 17, when we analyzed this data throughout the date range established for our analysis, we found a very clear shift between excess and carcass credits. From January 2008 until February 2009, 1st MLG received more excess credits than carcass credits. Then, from March 2009 until June 2011, it received more carcass than excess credits.

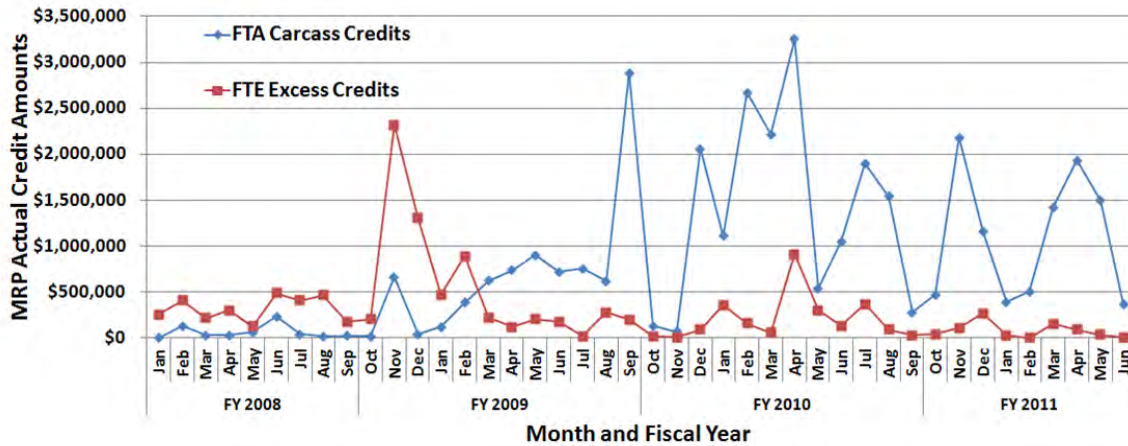


Figure 17. MRP Actual Credit Amounts for Excess (FTE) and Carcass (FTA) Transactions Over Time

Determining the exact reasons for this shift was outside the scope of our research because numerous variables were involved.

Overall, the excess credits have had a stable level of activity. The biggest spike in activity was from October to March of FY2009, which we believe was related to the USMC Logistics Modernization (LOGMOD) efforts to reduce the excess inventory across the entire Marine Corps.

The carcass credit activity had an obvious shift starting in September FY2009, and, since then, has maintained the increased activity level. From January FY2008 to August FY2009, there were 436 MRP carcass credits totaling \$6,143,940. In contrast, from September FY2009 to June FY2011, there were 2,411 MRP carcass credits totaling \$29,629,929. Therefore, for these periods, we saw a 552% increase in MRP carcass submissions (FTA transactions) from 1st MLG and a 482% increase in actual carcass credits received by 1st MLG.

As depicted in Figure 18, from June FY2010 to June FY2011, carcass (FTA) MRP actual credits made up 91.6% of all the actual credits that 1st MLG received. Excess (FTE) MRP actual credits made up only 8.4% of all the actual credits.

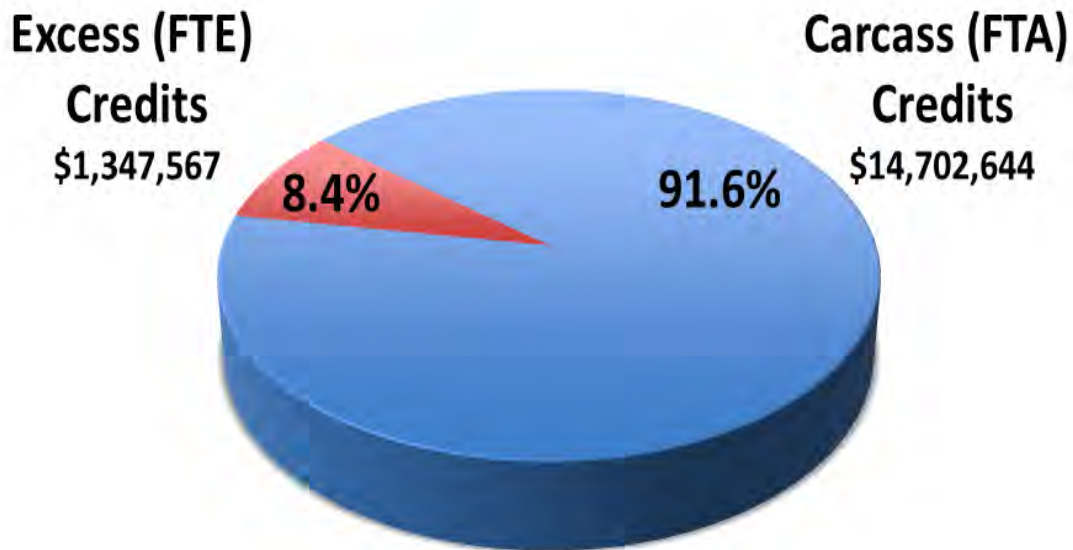


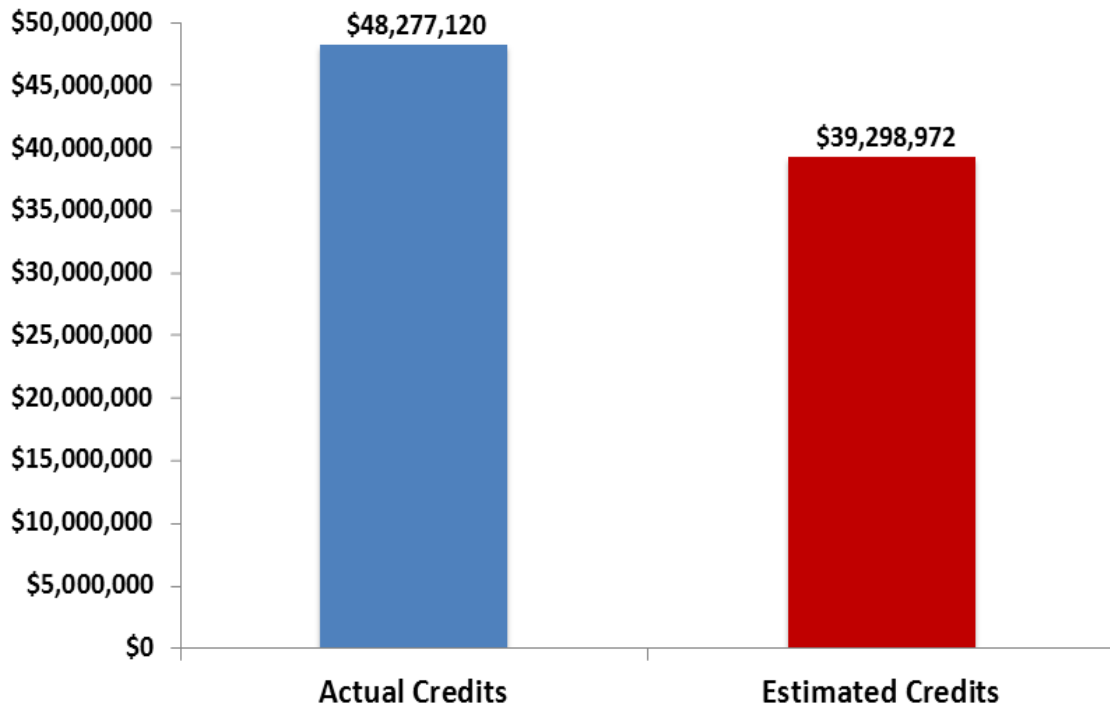
Figure 18. Excess (FTE) and Carcass (FTA) Dollar Amounts and Percentages from June FY2010 to June FY2011

A more thorough analysis of the trends associated with excess (FTE) and carcass (FTA) SECREPs may warrant additional research in the future.

3. Actual Credits vs. Estimated Credits

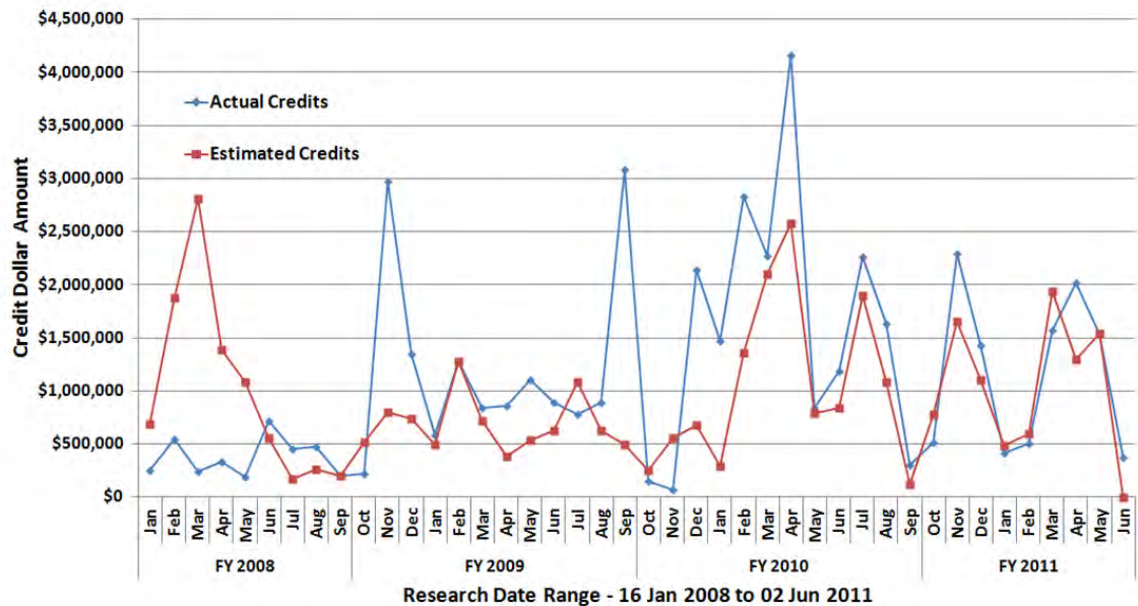
Our analysis of MRP estimated and actual credits included all SDNs, totaling 4,282, from January 16, 2008, to June 2, 2011, that met all of the following: were created in MRP with an FTE or FTA, resulted in an FTZ in MRP, and, finally, were given an FD2 in SABRS. This provided the complete cradle-to-grave data for each SDN. We included all the different variations of SECREPs—ground common (MMFAG8), low density (MMFAG3), excess (FTE), and carcass (FTA)—in these actual versus estimated credit amounts. Figure 19 depicts the

total actual credits versus the total estimated credit amounts, and Figure 20 depicts the actual credits versus the estimated credit amounts for each month in our data range.



Note. This table shows SDNs with cradle-to-grave data from January 16, 2008, to June 2, 2011.

Figure 19. Total Actual vs. Total Estimated MRP Credits



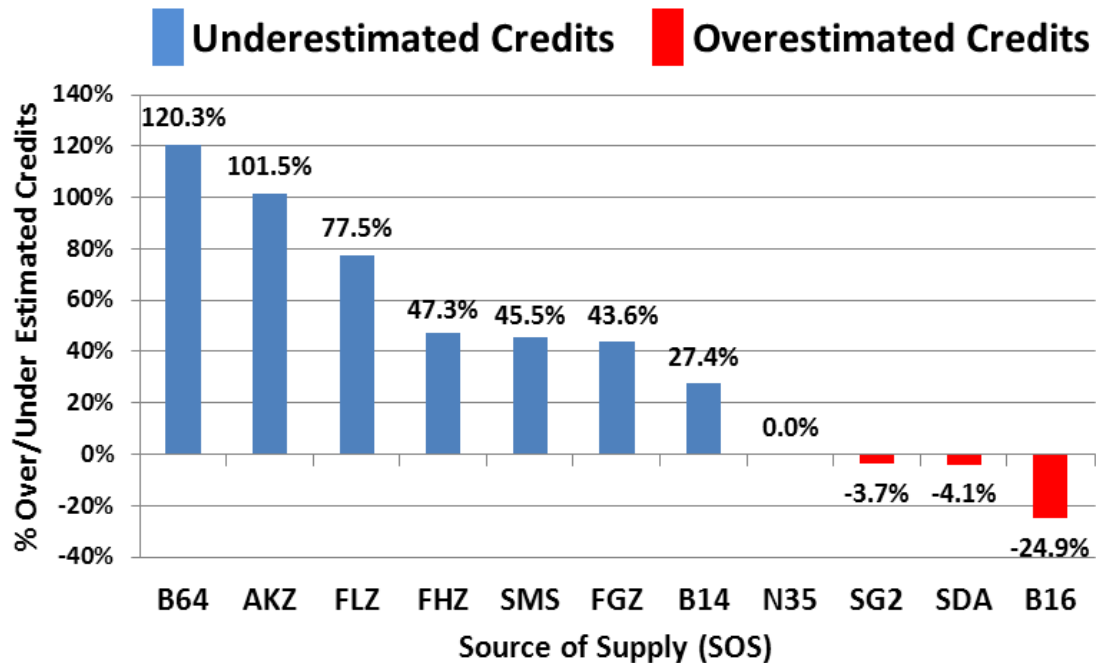
Note. This table shows SDNs with cradle-to-grave data from January 16, 2008 to June 2, 2011.

Figure 20. Total Actual vs. Total Estimated MRP Credits in Data Range

Historically, 1st MLG received more actual credits than the SOSs estimated. Our data range included \$39,298,972 estimated credits in MRP (FTZs) and \$48,277,120 actual credits in SABRS (FD2s). Therefore, 1st MLG received \$8,978,148 more credits in SABRS (FD2) than the SOSs estimated in MRP (FTZ).

a. SOS Credit Underestimation and Overestimation

Our analysis revealed that the RIP utilized 11 SOSs for the MRP during the date range we analyzed. We conducted an analysis of the SOSs that were underestimating or overestimating their MRP credits. Figure 21 shows the percentage of underestimated and overestimated credits by SOS, the actual and estimated credit amounts, and the difference between the two credit amounts.



Note. SDNs with cradle-to-grave data from January 16, 2008, to June 2, 2011.

Figure 21. Percentage of Overestimated and Underestimated MRP Credits for All Sources of Supply (SOS)

According to our research data, seven SOSs underestimated, one estimated correctly (an estimate of only \$4,620), and three overestimated. The cumulative difference between all the SOSs equaled the \$8,978,148 actual MRP credits 1st MLG received in excess of what the SOSs estimated.

Out of the 4,282 SDNs that we analyzed, 266 SDNs were underestimated and 234 were overestimated. These 500 SDNs made up only 11.67% of all the SDNs; therefore, 88.33% of all SDNs had a correct MRP credit estimation.

Our analysis of the 266 underestimated SDNs revealed that 135 different NSNs were associated with these SDNs, resulting in a total difference between estimated and actual credits of \$13,925,831. 1st MLG submitted NSN 2835015482910, a tank engine (Tank, 105MM, M1/M1IP), 24 times, which resulted in \$5,375,373 of the underestimated credits. This one NSN made up 39% of all the underestimated credits. All of the other 134 NSNs accounted for

the remaining 61%. Most of the underestimated NSNs were carcasses (FTA in MRP), condition code F, and ground common SECREPs (MMFAG8) that were each underestimated only one time.

Our analysis of the 234 SDNs that the SOSs overestimated revealed that 128 different NSNs were associated with these SDNs, resulting in a total negative difference between estimated and actual credits of -\$6,972,682. Four NSNs made up 44% of all the overestimated credits: NSN 5895011954844, Amplifier (SINCGARS,²⁴ ground radio), occurred 16 times; NSN 5820014111421, Exciter (SINCGARS, ground radio), occurred 14 times; NSN 5998014551794, Backplane Assembly (SINCGARS, ground radio), occurred 12 times; and NSN 5895013343164, Amplifier adapter (SINCGARS, ground radio), occurred 10 times. These four NSNs resulted in \$3,030,673 of the overestimated credits. All of the other 124 NSNs accounted for the remaining 56%. Most of the overestimated NSNs were excesses (FTE in MRP), condition code F, and ground common SECREPs (MMFAG8) that were each overestimated only one time.

In summary, our credit analysis focused on the actual MRP credits 1st MLG received in SABRS and the estimated credits provided by the sources of supply (SOSs) in the MRP. In this section we analyzed the SOSs that accounted for the largest numbers of actual MRP credits, the percentages of ground common/low density and excess/carcass, the comparison of total actual versus estimated credit amount, and a breakdown of the resulting underestimated and overestimated credits. In the next section of this chapter, we describe our analysis of the MRP credit lead-times.

B. ANALYSIS OF CREDIT LEAD-TIMES

For the purpose of our research, credit lead-time refers to the number of days from the RIP notifying the SOS of an excess or carcass in MRP (FTE or FTA transaction) to the SOS issuing a financial credit to the RIP in SABRS (FD2 transaction). We started with an analysis of all documents in our entire data

²⁴ Single Channel Ground-Air Radio System (SINCGARS).

range, and then we identified and briefly described outliers that could interfere with a more detailed analysis. Next, we focused the analysis on specific areas to highlight trends and patterns within the data. Specifically, we analyzed the variability in lead-times between SOSs and the effect that factors such as NSN and condition code have on MRP credit lead-time.

1. Analysis of All Lead-Time Data

Lead-time analysis of our complete data range resulted in the descriptive statistics displayed in Table 5.

Table 5. MRP Credit Lead-Time Descriptive Statistics (All Data)

Lead-time FTE/A to FD2	
<i>Count</i>	4282
<i>Minimum</i>	5
<i>Maximum</i>	990
<i>Range</i>	985
<i>Mean</i>	33.66
<i>Median</i>	22
<i>Mode</i>	14
<i>Variance</i>	1578.54
<i>Standard Deviation</i>	39.73
<i>Skewness</i>	9.51
<i>Coefficient of Variation</i>	1.18

The 4,282 documents had a mean of 33.66 days and a median of 22 days, and they ranged from five to 990 days. As depicted in Figure 22, our analysis revealed a clear cluster of SDNs with lead-times of fewer than 200 days. However, lead-times extending as far out as 990 days impacted the mean. In our

analysis of credit lead-times, we used median rather than mean. With a range of 985 days, the outliers affected the median less, making it more representative of the data's central tendency.

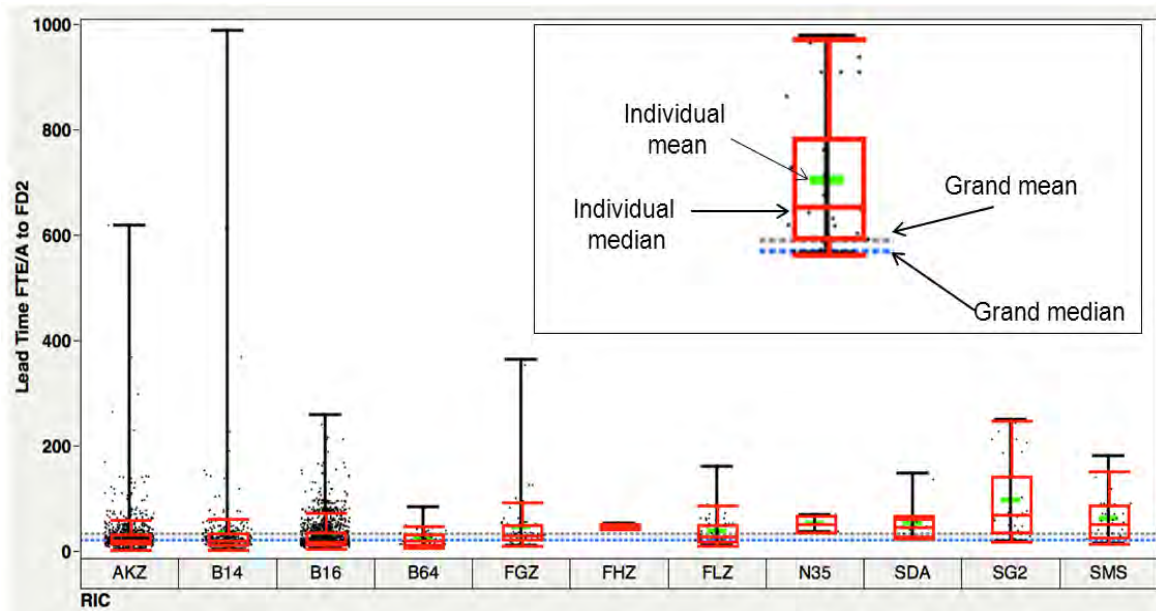


Figure 22. Lead-Time Variability Chart by Source of Supply (All Data)

Through this analysis, we also determined which SOSs do not have a significant impact on 1st MLG's median credit lead-times. For example, N35 and FHZ collectively contained only four SDNs, totaling \$21,315 in MRP credits. Because they made up only 0.009% of all SDNs and 0.004% of all credit dollars, we omitted N35 and FHZ from further analysis.

2. Distribution of Credit Dollars by Lead-Time

The longest lead-time we identified within the data was 990 days, which is over 2.5 years. However, as Figure 23 shows, almost all of 1st MLG's MRP credits posted within six months: 56% within 30 days, 95% within 90 days, and 99% (\$47.7 million of \$48.3 million) within 180 days.



Figure 23. Cumulative MRP Credits by Lead-Time

3. Description of SDNs With Lead-Times Greater Than 180 Days

Our data contained only 38 documents with lead-times between 180 and 990 days. Those 38 documents totaled \$517,114 in actual credits, which represented 1% of 1st MLG's total MRP credits.

The 38 documents with lead-times exceeding 180 days came from six of the 11 SOSs in our data. Figure 24 depicts the proportion of SDNs by SOS for the entire data range (left pie chart) and the proportion of SDNs by SOS for documents with credit lead-times exceeding 180 days (right pie chart). Table 6 contains the supporting data.

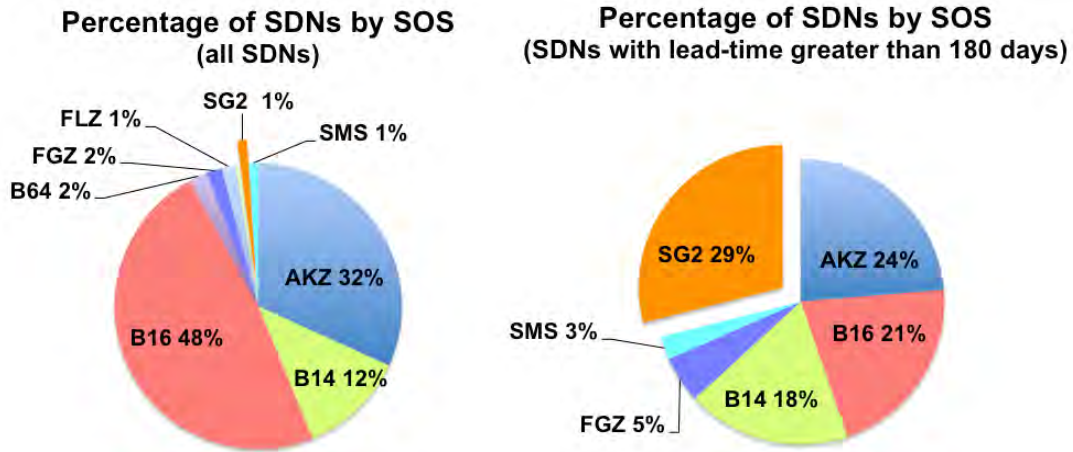


Figure 24. Comparison: Percent of Total SDNs by SOS for Total Data Range vs. SDNs With Credit Lead-Times Exceeding 180 Days

SOS	Total # of SDNs in Data Range	% of Total SDNs in Data Range	# of SDNs with Lead-Time >180	% of SDNs with Lead-Time >180
AKZ	1363	31.83%	9	24%
B16	2065	48.23%	8	21%
B14	514	12.00%	7	18%
FGZ	76	1.77%	2	5%
SMS	43	1.00%	1	3%
SG2	46	1.07%	11	29%
B64	88	2.06%	0	0%
FHZ	2	0.05%	0	0%
N35	2	0.05%	0	0%
SDA	20	0.47%	0	0%
FLZ	63	1.47%	0	0%
Totals	4282		38	

Table 6. Data for Figure 24

We used this analysis to highlight that although only 1% of the documents in our complete data range came from SG2 (\$396,367), 29% of the documents with lead-times greater than 180 days came from SG2 (\$81,339). SG2 is the only SOS with disproportionate representation in the 38 SDNs with credit lead-times exceeding 180 days.

Lastly, we checked to see whether the NSNs associated with the 38 SDNs with lead-times greater than 180 days were also present in documents with shorter lead-times. Of the 29 NSNs, all but four also had documents with lead-times of 180 days or less. Table 7 identifies the four NSNs whose lead-times always exceeded 180 days.

Table 7. NSNs With Credit Lead-Times Consistently Over 180 Days

NSN	SOS	# of SDNs	Average Lead-Time	Total Credit Value
1015012592896	B14	2	543	\$3,465
5998011666128	AKZ	1	620	\$809
5998014444643	FGZ	1	354	\$7,172
6130013091772	FGZ	1	365	\$8,529
				\$19,975

In order to capture a more accurate representation of the data, we treated all documents with credit lead-times greater than 180 days as outliers and omitted them from further analysis. Figure 25 highlights the 38-outlier documents we omitted from further analysis.

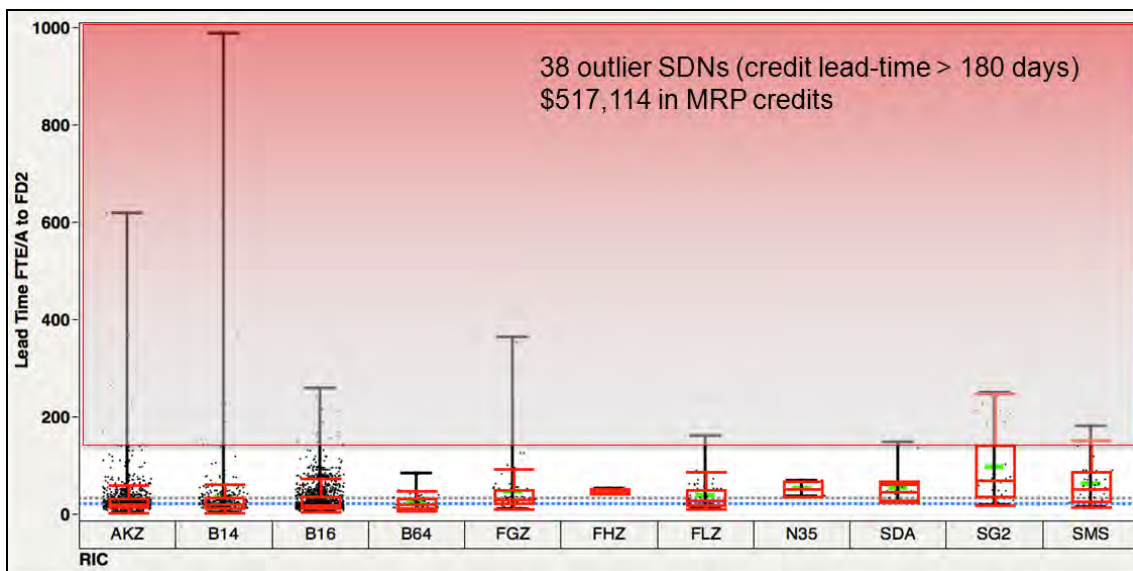


Figure 25. Outlier SDNs With Credit Lead-Times Greater Than 180 Days

4. Analysis of SDNs With Lead-Times Less Than 180 Days

All further analysis of credit lead-times included only those documents that had MRP credits that posted in SABRS via FD2 transaction within 180 days of the RIP submitting the FTE or FTA transaction in MRP. Lead-time analysis of those documents resulted in the descriptive statistics contained in Table 8. Note that when we eliminated documents with lead-times greater than 180 days, the median remained 22 days, while the mean changed from 33.6 to 30.09 days and the standard deviation from 39.7 to 23.5 days.

Table 8. Descriptive Statistics of SDNs With Lead-Times Less Than 180 Days

Lead Time FTE/A to FD2 (Documents with lead-time <181 days)	
<i>Count</i>	4240
<i>Minimum</i>	5
<i>Maximum</i>	170
<i>Range</i>	165
<i>Mean</i>	30.09
<i>Median</i>	22
<i>Mode</i>	14
<i>Variance</i>	556.33
<i>Standard Deviation</i>	23.59
<i>Mean Standard Error</i>	0.36
<i>Skewness</i>	2.31
<i>Coefficient of Variation</i>	0.76

We performed a goodness-of-fit test and determined that the credit lead-times for these documents made up a lognormal distribution. To validate the distribution and statistics we derived from our observed data, we used Crystal Ball to simulate 10,000 iterations of the median lead-time. As depicted in Figure 26, this simulation resulted in only minor statistical differences between the lead-times in our original data and the lead-times simulated in Crystal Ball. Table 9 contains the supporting data for Figure 26.

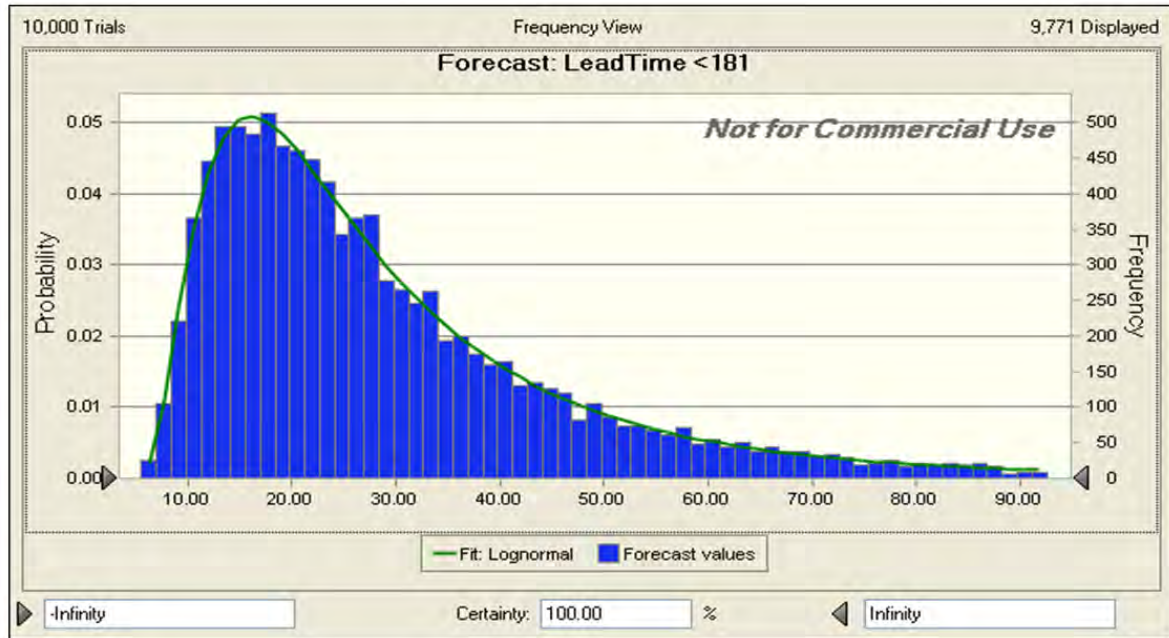


Figure 26. Median Lead-Time (< 181 Days) Simulation Results

Table 9. Data for Figure 26 Results

Statistic	Observed Lead-Times	Forecast with 10K Iterations
Trials	-----	10,000
Mean	30.09	30.65
Median	22	24.31
Mode	14	-----
Standard Deviation	23.59	22.09
Variance	556.33	488.15
Skewness	2.31	2.74
Kurtosis	25.40	15.62
Coeff. of Variability	0.78	0.72

The simulation generated a longer median lead-time, 24 versus 22 days, but a tighter standard deviation, 22.09 versus 23.58 days. These statistics indicate that over time, given an increase in observed data, the median lead-time could be slightly longer than we observed in our data, but the distribution of the individual lead-times would be slightly tighter around that median. However, in this case, the median should not be used by itself as an accurate predictor of

future lead-times. The lognormal distribution is skewed right with a fat tail that results in a significant standard deviation and a coefficient of variation close to 1.0.

As described in the following subsections, we analyzed how SOS, NSN, and condition code affected MRP credit lead-times.

a. Analysis of Lead-Time by SOS

In this section, we present an analysis of the variation in lead-times between SOSs. Figure 27 highlights how the lead-times within each SOS are distributed around the grand median²⁵ of 22 days. Only one SOS had a median under the grand median (B16, 20 days), while three were within one day of the grand median (AKZ and B14, 23 days; and B64, 22 days). The remaining SOSs had median lead-times from nine to 50 days longer than the date range's grand median.

²⁵ The statistical software program JMP uses the term *grand median* to describe the overall median of an entire sample across multiple categories. For the purpose of our research, grand median lead-time refers to the overall median of all SDNs from all SOS.

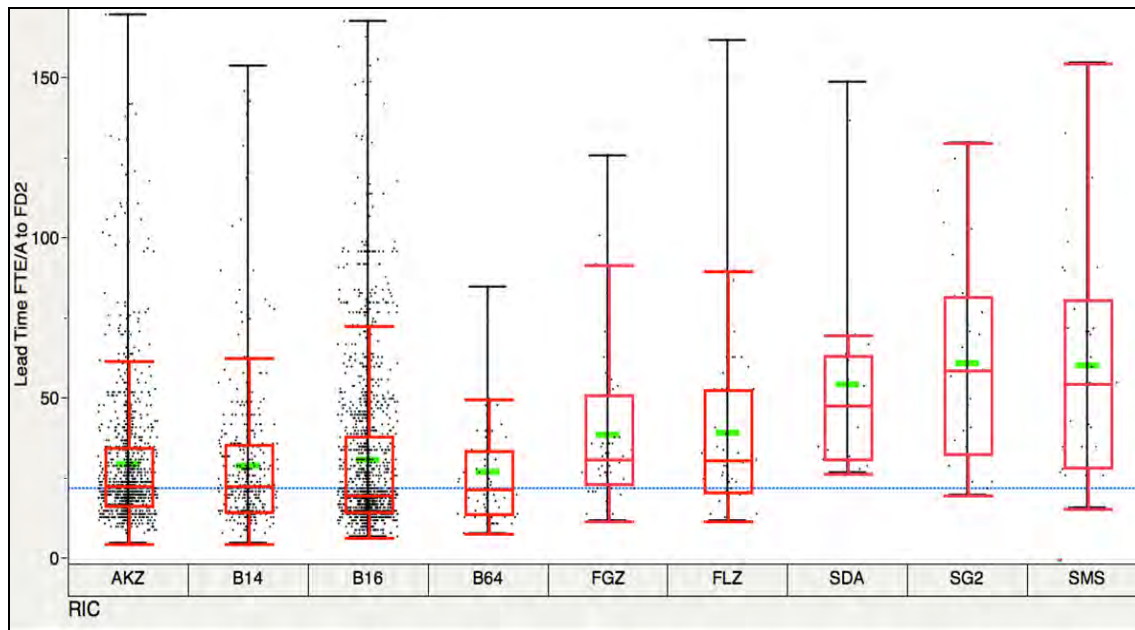


Figure 27. Lead-Time Variability by Source of Supply (180 Days or Less)

Although five of the nine SOSs had median lead-times that exceeded the grand median by as many as 50 days, these five SOSs had relatively little overall impact on 1st MLG's total MRP credits. As depicted in Figure 28, the five SOSs with median lead-times greater than the grand median collectively made up only 5% of all SDNs and 7% of all MRP credits at 1st MLG. The grand median for MRP credit lead-times at 1st MLG were driven by only three of the 11 sources of supply: AKZ, B14, and B16. Table 10 contains the data for Figure 28.

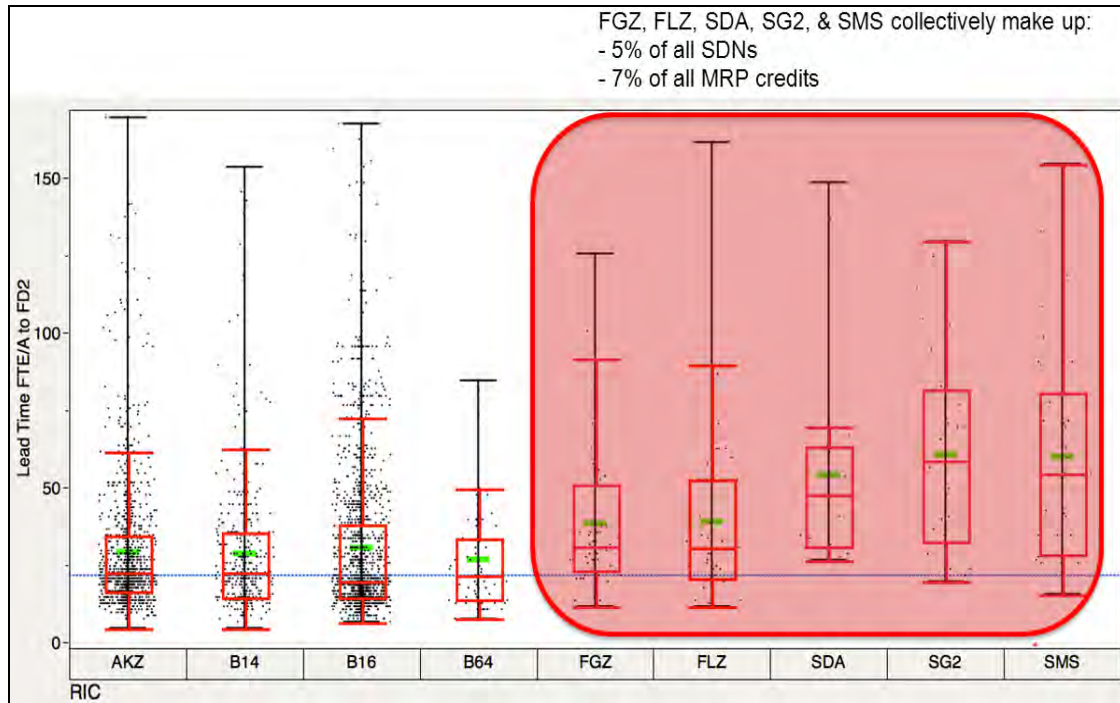


Figure 28. Summary of Sources of Supply with Median Lead-Times Greater Than 22 Days

Table 10. Data for Figure 28

SOS	Median Lead-Time	# of SDNs	% of Total SDNs	Total Credit \$	% of Total Credit \$
FGZ	32	74	2%	\$1,747,136	4%
FLZ	31	63	1%	\$541,229	1%
SDA	48	20	0.47%	\$225,602	0.47%
SG2	72	35	1%	\$396,367	1%
SMS	55	42	1%	\$347,151	1%
Total		234	5%	\$3,257,485	7%

b. Analysis of Lead-Time by NSN

Out of the 805 total NSNs found in our complete data range, 26 of those NSNs generated \$250,000 or more during the period we examined. These 26 NSNs were included in 781 SDNs, which resulted in \$28,043,400 in credits. For example, in one case, 1st MLG submitted two MRP SDNs for tank thermal

receivers (NSN 1240012718060) and received \$330,486 in MRP credits. In another example, 1st MLG submitted 168 SDNs for SINCGARS radio transmitter-receivers (NSN 5820013652725) and received \$4,255,355 in MRP credits. Table 11 contains the data for the top 26 MRP credit-generating NSNs at 1st MLG and also highlights the range of differences between the minimum and maximum lead-times for those NSNs. For NSNs that appeared in more than one SDN (the RIP submitted an NSN to the SOS on multiple occasions), we analyzed the difference between the minimum and maximum lead-times. The lead-times for these documents had a median of 24 days and a standard deviation of 24.3 days.

Table 11. Lead-Time Data for NSNs That Generated Greater Than \$250,000 in MRP Credits

NSN	Median Lead-Time	Min Lead-Time	Max Lead-Time	Range	# of SDNs	Total Credit \$
1025010386013	75	32	129	97	3	\$314,702
5975013169270	49	49	49	0	1	\$315,320
5975015373765	45.5	16	155	139	18	\$911,763
5820013636929	35.5	15	84	69	32	\$721,822
2520013259834	35	15	265	250	7	\$1,509,941
5980014804875	32	14	80	66	18	\$207,844
5820013652725	31	11	114	103	168	\$4,255,355
2815014617078	29	12	132	120	84	\$613,413
6110014976960	29	9	53	44	23	\$1,479,820
5975014599483	28	13	56	43	39	\$1,317,634
2815014146821	27	18	51	33	5	\$1,274,277
2835014657020	25	19	143	124	6	\$1,569,260
5855014804876	24*	9	80	71	18	\$330,187
2835015482910	24*	10	77	67	23	\$6,407,208
6110015147369	24*	14	63	49	10	\$585,212
5996015346853	24*	12	30	18	3	\$402,212
2910013390029	21.5	5	131	126	32	\$552,969
1240012718060	20	19	21	2	2	\$330,486
5895013343164	19	9	84	75	68	\$768,833
5895014441218	18	10	149	139	47	\$375,431
5963014746208	18	10	106	96	35	\$757,445
7021015542707	18	9	80	71	56	\$387,435
2835014087048	18	11	27	16	6	\$1,411,967
5895014210093	17	9	149	140	52	\$365,466
6110015171380	16	9	66	57	13	\$513,744
1220015721096	15	10	141	131	12	\$363,654

* Median credit lead-time for NSNs generating > \$250K in MRP credits

Credit lead-times for these documents ranged from five to 265 days with a median of 24 days. Eleven of the 26 NSNs had a difference of 90 or more days between their minimum and maximum credit lead-times.

Reviewing one particular NSN illustrates these statistics. Between February 2008 and June 2011, 1st MLG submitted NSN 2520013259834 (hydraulic transmission for an M1A1 tank) to the MRP seven times. Table 12 contains the data for those SDNs.

Table 12. Credit Lead-Times for NSN 2520013259834

SDN	FD2 lead-time
MMFAG88032E334	15
MMFAG88205E300	18
MMFAG80216338E	19
MMFAG88291X020	35
MMFAG88312E488	39
MMFAG88310E467	46
MMFAG80062024E	265

The final document, with the 265-day lead-time, resulted in \$238,231 in MRP credits. Although the median lead-time for this high-dollar item was 27 days, 1st MLG had almost \$250,000 held up for close to nine months on this single document. This example highlights a trend we found across the entire data range. Despite a relatively low median credit lead-time for all SDNs, the outliers lead to a large standard deviation. This becomes increasingly more important as the dollar value of the SDN increases. Cases such as these offer the RIP leadership the specific opportunity to manage by exception.

c. Analysis of Lead-Time by Condition Code

We identified seven different condition codes in our data range; however, five of those condition codes, B, H, K, S, and U, collectively made up less than 0.01% of all documents in our data, so we omitted them from further analysis. Condition codes A (serviceable) and F (unserviceable) made up over 99% of all documents in our data range. Figure 29 depicts the variability in credit lead-time between condition codes A and F.

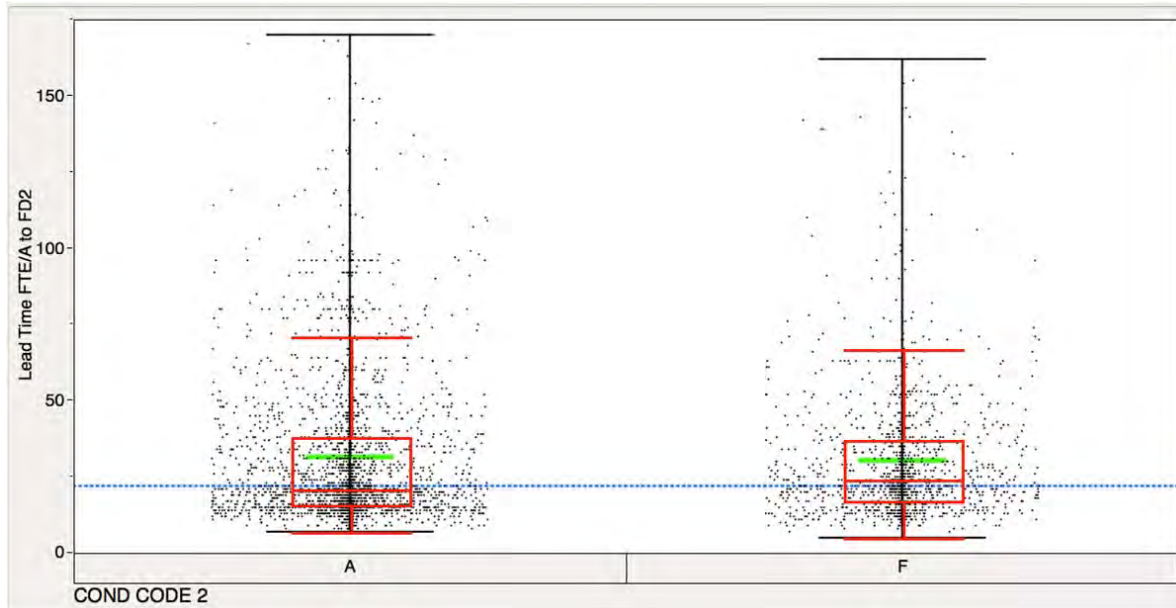


Figure 29. Variability in Credit Lead-Time by Condition Code

The median lead-times and standard deviations were 21 and 32 days, respectively, for condition code A, and 24 and 50 days for condition code F. One possible explanation for the larger standard deviation with condition code F is that the RIP submitted some of those documents to the SOS as condition code A. Upon receipt of the item, the SOS discovered something during their inspections that led them to downgrade the condition code to F. SOSs downgraded condition codes from A to F on approximately 9%, or 39, of the 471 documents the RIP submitted as condition code A. Despite the higher standard deviation for condition code F SDNs, we concluded through this analysis that condition code does not have any significant impact on the credit lead-time of MRP documents at 1st MLG.

C. SUMMARY OF DATA ANALYSIS AND PRESENTATION

In our analysis of historical MRP and SABRS data, we focused on two main areas: (1) MRP credits and (2) MRP credit lead-times. The analysis enabled us to answer our primary and secondary research questions, as we discussed in Chapter V.

In the MRP credits section, we ascertained the following key statistics from our analysis:

- Sources of supply AKZ (TACOM, Warren, MI), B16 (CECOM, Monmouth, NJ), and B14 (ACALA, Rock Island, IL) provided 91.12% of the MRP actual credits, totaling \$43,989,235. All eight of the remaining SOSs made up only 8.88% of MRP actual credits, totaling \$4,287,867.
- Ground common (MMFAG8) MRP actual credits made up 88.2% of all the actual credits that 1st MLG received, totaling \$42,601,901. Low density (MMFAG3) MRP actual credits made up 11.8% of all the actual credits, totaling \$5,675,219.
- Carcass (FTA) MRP actual credits made up 74.1% of all the actual credits and excess (FTE) MRP actual credits made up 25.9% of all the actual credits that 1st MLG received during the SDN range we analyzed. However, from June FY2010 to June FY2011, carcass (FTA) MRP actual credits made up 91.6% of all the actual credits that 1st MLG received. Excess (FTE) MRP actual credits made up only 8.4% of all the actual credits.
- 1st MLG received more actual credits than the SOSs estimated. Our data range included \$39,298,972 in estimated credits in the MRP (FTZs) and \$48,277,120 in actual credits in SABRS (FD2s). Therefore, 1st MLG received \$8,978,148 more in credits in SABRS (FD2) than the SOSs estimated in the MRP (FTZ).
- Out of the 4,282 SDNs that we analyzed, 266 SDNs were underestimated and 234 were overestimated. These 500 SDNs of underestimated and overestimated credits made up only 11.67% of all the SDNs; therefore, 88.33% of all the SDNs had a correct MRP credit estimation.

In the MRP credit lead-time section, we ascertained the following key statistics and information from our analysis:

- Despite some SDNs taking as long as 990 days to post credits in SABRS, 95% of 1st MLG's MRP credits posted within 90 days of the RIP submitting a new MRP document to an SOS.
- Some differences in median lead-times existed between the different SOSs. However, the median MRP credit lead-time at 1st MLG was driven by three SOSs: AKZ, B14, and B16. Although the remaining eight SOSs contained outliers with median lead-times up to 50 days longer than the grand median, these outliers produced only 7.47% of 1st MLG's MRP credits during the date range we analyzed.

- Whether considering SOS, NSN, or condition code, we discovered that credit lead-times consistently followed a lognormal distribution with medians between 22 and 24 days.
- The lognormal distribution and significant standard deviation associated with MRP credit lead-times at 1st MLG prevented us from using any measure of central tendency by itself as an accurate predictor of future credits.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

Our research resulted in a descriptive analysis of historical MRP credits at 1st MLG. Throughout the research and analysis process, we answered our primary and secondary research questions along with some other overarching conclusions about the Materiel Returns Program. Additionally, we identified several opportunities for future research, which we address as recommendations following the summary of our conclusions.

1. Conclusion to Primary Research Question

The purpose of our research was to determine whether an analysis of historical MRP credits at 1st MLG could be used to forecast the timing and magnitude of expected credits. Our analysis of MRP credits at 1st MLG indicates that it should be possible to forecast expected credits.

We support this conclusion with two main findings:

- 88.33% of the time, the MRP credits SOSs issued to 1st MLG in SABRS matched the estimated credit amounts provided by the SOS.
- 95% of 1st MLG's MRP credits posted within 90 days of the RIP submitting a new MRP document to a SOS.

These findings indicate that for an overwhelming majority of the items 1st MLG submitted to a SOS through MRP, the estimated credit amount provided by the SOS equaled the actual credit amount paid by the SOS (88.3%) and the SOS paid that credit within 90 days of the RIP initiating that SDN (95%). These large percentages lead us to believe that 1st MLG could use a forecasting method to predict future credits based on active MRP documents.

Next, we address the conclusions for our secondary research questions. The answers to these questions support our primary research question, but they are also significant as stand-alone findings.

2. Conclusions to Secondary Research Questions

What are the differences between MRP estimated credits and the actual credits 1st MLG received?

In aggregate, 1st MLG's actual MRP credits in SABRS exceeded the SOSs' estimated credits by 18.6%. Our research found \$39,298,972 in estimated credits and \$48,277,120 in actual credits. Although a difference exists, 88.33% of the time the SOS issued a credit in SABRS that was identical to their estimate in MRP.

What percentage of MRP credits does 1st MLG receive within 30, 90, and 180 days of submitting a new MRP document to the SOS?

1st MLG received 56% of all MRP credits within 30 days, 95% within 90 days, and 99% within 180 days.

In addition to answering our primary and secondary research questions, our analysis uncovered several other relevant conclusions. These findings guided our recommendations for potential future research into MRP.

3. Additional Conclusions

a. Primary Drivers of MRP Credits at 1st MLG

Our research showed that between January 16, 2008, and June 2, 2011, 1st MLG submitted 806 different NSNs to 11 different SOSs via MRP. However, each NSN and SOS did not have the same impact on MRP credit trends. Our analysis highlighted that a relatively small number of NSNs and SOSs drove trends associated with MRP credits at 1st MLG.

Of all MRP credits issued to 1st MLG, 91% came from only three of the 11 SOSs: AKZ, B16, and B14. In addition to accounting for less than 9% of the MRP credits, the remaining nine SOSs had virtually no effect on median credit lead-time.

b. Challenges with Data

At the time of our research, no single repository, system, or database contained all the data required to conduct a thorough analysis of MRP credits. We had to pull data from multiple legacy systems, SABRS and MRP, reformat it, and merge it into a single document that could be analyzed. However, MRP archive limitations still restricted the range of data available for analysis. As we explained in Chapter III, the principal limitation on analysis of MRP credits was that the MRP Closed Document History File archives only two years of data.

c. System Defects

Our analysis indicated that the MRP process/system works as intended with respect to credits. All things being equal, if the RIP submits an MRP document today, there is a 95% chance that 1st MLG will receive the actual credit within 90 days and an 88% chance that the credit in SABRS will match the SOS's estimate in the FTZ transaction. In reality though, all things are not equal. Different factors introduce degrees of variation in both credit amount (accuracy between estimate and actual) and lead-time. One method of analyzing these variations is to consider them as defects in the system.

B. RECOMMENDATIONS

Our research consisted of descriptive analytics of MRP credits at 1st MLG. We conducted trend analysis to determine what happened in the past and drew overarching conclusions about MRP credits and the program. Our recommendations revolve around the necessity for continued research on this topic. In order to forecast what could happen in the future (prescriptive analytics) or to optimize what should happen in the future (predictive analytics), certain forecasting methods or models will need to be created (Nestler, 2011).

In FY2011, 38% (\$25.9 million) of 1st MLG's total planned budget (\$68.4 million) went to RIP operations; MRP credits effectively increased 1st MLG's total obligation authority by 27%. Continued research on this topic is critical if 1st

MLG, and the Marine Corps as a whole, are to take full advantage of the fiscal opportunity presented by MRP credits. Doing so could result in MRP process improvements and more efficient budgeting in a fiscally constrained environment. The next sections list our recommendations for future research.

1. Develop Forecast Model

We concluded through our research that forecasting expected MRP credits should be possible. Further research should be conducted to develop a method of forecasting expected MRP credits. Any method that is developed should be able to interface with all the legacy systems that are currently being utilized and with Global Combat Support System-Marine Corps (GCSS–MC).

2. Conduct Enterprise-Wide Analysis to Compare and Contrast MLGs

During our research, we were unable to locate any prior research on MRP credits within any Marine Force (MARFOR) or at the enterprise level of the USMC. We recommend extending our descriptive analytical research to include the other MARFORs. Similar trend analysis of MRP credits across the USMC could assist with identifying and promulgating, enterprise-wide, best practices associated with the MRP process.

3. Determine the Effects of GCSS–MC on Ability to Manage MRP

In order to conduct our research, we had to pull data from multiple legacy systems, reformat it, and merge it into a single integrated and relational data set. No single system, repository, or database contained all data required to conduct a thorough analysis of MRP credits. After we completed our research, 1st MLG transitioned to GCSS–MC. We recommend further research to determine what effects GCSS–MC has had on 1st MLG's ability to manage the MRP and to determine its impact on credits.

4. Develop Metrics to Measure the Accuracy of SOS Estimates

In 2009, LOGCOM identified total materiel returns credits as an area requiring a method for tracking at the enterprise level (Marine Corps LOGCOM, 2009). LOGCOM listed this requirement as, “Information to Capture During the Conduct of the POP Pilot Test” (Marine Corps LOGCOM, 2009, p. 18). As of the completion of our research, we were unable to determine whether LOGCOM achieved this requirement. If it does not yet exist, we recommend further research to develop a method of tracking and analyzing MRP credits at the enterprise level.

5. Investigate Root Causes of System Defects (Poor Credit Accuracy/Long Credit Lead-Times)

We identified one area where 1st MLG may be able to increase the number of MRP credits they receive from SOSs. Our data contained 576 SDNs for which the SOS ultimately did not issue an MRP credit for what appear to be preventable reasons. The status codes on the SOS FTZ transactions indicated reasons such as the RIP sending an item not authorized for return, the item’s condition being different from what the RIP reported, and the item not arriving at the SOS within the prescribed timeframe.

We do not suggest that the RIP or SOSs bear the full responsibility for these defects, but some level of human error in the process could be the root cause of these preventable defects. We did not analyze the MRP process itself or the human-element touch points within that process.

We recommend additional research into the MRP process, specifically to determine the root causes of system defects and their associated effects on MRP credits. One possible method of analyzing the system defects would be applying a Six Sigma root cause analysis.

C. THESIS CONCLUSION

Budgets are shrinking, but 1st MLG will maintain a high operational tempo for the foreseeable future. This dynamic places a significant challenge on 1st MLG's comptroller who must determine the most efficient allocation of increasingly scarce resources. Our research shows that the comptroller has a unique opportunity to squeeze even more efficiency out of 1st MLG's budget by applying MRP credits to planned resource requirements. MRP credits have increased 1st MLG's total obligation authority by 27% annually since 2008; however, the comptroller has been unable to leverage these funds due to an inability to forecast future credits. Our research shows that forecasting MRP credits should be possible. We believe that continuing research on MRP with the topics we recommend will make forecasting MRP credits possible.

APPENDIX A. USMC MAINTENANCE

Marine Corps maintenance has been in a transition phase over the last decade and is still realigning its maintenance approach. Simply put, maintenance for Marine Corps ground equipment has been transitioning from five echelons of maintenance (EOM) to three levels of maintenance (LOM), defined as realignment of maintenance (ROM).

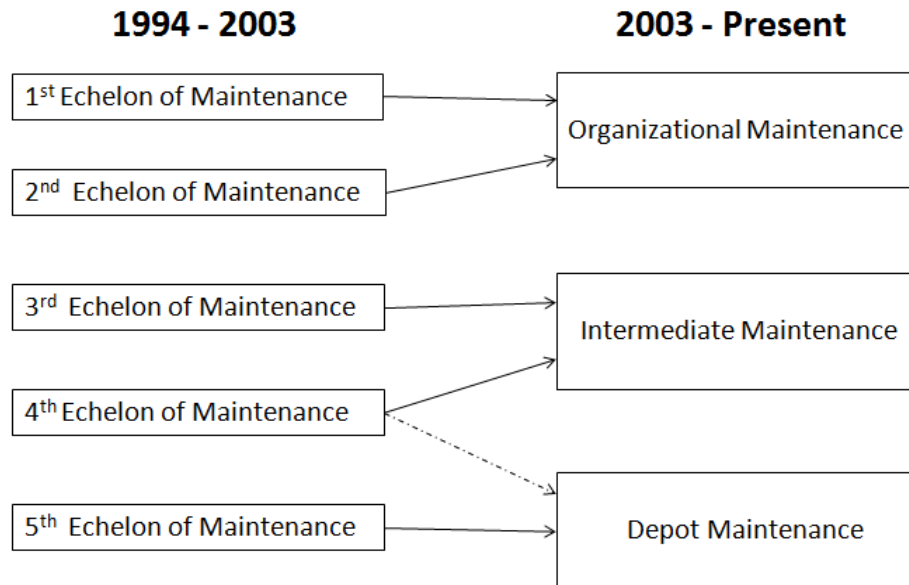


Figure 30. USMC Realignment of Maintenance (ROM)

The Marine Corps is currently working to publish a new order, MCO 4790.23 Ground Equipment Maintenance Policy, but has been stalled due to conversion issues with the Global Combat Support System Marine Corps (GCSS–MC) and a naming convention that is standardized with other Services. Therefore, at the time this thesis was written, the definitions in this appendix are the official definitions for USMC maintenance.

The Marine Corps defines maintenance as “all action taken to retain materiel in or restore it to a specified condition. It includes: inspection, testing, servicing, classification as to serviceability, repair, rebuilding, and reclamation” (HQMC, 1994, p. 1–3).

The Marine Corps approved a Realignment of Maintenance (ROM) initiative in 1999. In 2003, MARADMIN 581/03, Establishment of Three Levels of Maintenance, was published

to announce the establishment of three levels of maintenance on USMC ground equipment. ... Historically, the Marine Corps has performed five Echelons of Maintenance (EOM) on ground equipment ... today the EOM approach reduces maintenance effectiveness. ... Ground maintenance production is also hindered by fragmented maintenance processes, which result from redundant MAGTF layering and a lack of single process owner for maintenance. ...The Marine Corps has determined that three Levels of Maintenance (LOM) vice five echelons is the most effective approach to ground maintenance in support of all MAGTFs. ... Transitioning from five EOM into three LOM have been integrated into one consolidated effort entitled Realignment Of Maintenance (ROM). (HQMC, 2003, p.1)

The three levels are defined in MARADMIN 581/03 as follows:

Organizational Level

The intent of organizational level maintenance is sustaining equipment in a mission capable status and is both preventive and corrective in nature. Organizational level maintenance includes expeditious assessment and maintenance conducted under battlefield conditions. Organizational level maintenance normally entails inventory, cleaning, inspecting, preserving, lubricating, adjusting and testing, as well as replacing parts and components with common shop tools per individual training standards (ITS) and/or training and readiness events (TRE) and technical publications.

Intermediate Level

The intent of intermediate level maintenance is to return equipment to a mission capable status and is both preventative and corrective in nature. Intermediate level maintenance actions include inspection/in-depth diagnosis, modification, replacement,

adjustment, and limited repair or evacuation/disposal of principle end items and their selected reparables and components/sub-components. Intermediate level maintenance also includes calibration and repair of test, measurement and diagnostic equipment (TMDE), as well as fabrication of items, precision machining, and various methods of welding. Intermediate level maintenance is performed by specially trained mechanics and technicians per individual training standards (ITS) and/or training and readiness events (TRE) and technical publications.

Depot Level

The intent of depot level maintenance is to sustain equipment throughout its life cycle by performing major repair, overhaul, or complete rebuild of parts, subassemblies, assemblies or principle end items to include manufacturing parts and conducting required modifications, testing, calibrating, and reclaiming. Marine Corps multi-commodity maintenance centers, other service depots, commercial industrial facilities, original equipment manufacturer or a combination thereof may perform depot level maintenance. Depot level maintenance also supports lower level maintenance by providing overflow maintenance services, and by performing on site maintenance services including technical assistance when required. (HQMC, 2003, p. 2)

According to MCO P4790.2C, the *Marine Corps Integrated Maintenance Management System (MIMMS) Field Procedure Manual* (HQMC, 1994), the Marine Corps historically defined the maintenance levels and echelons of maintenance as follows:

Maintenance is divided into field and depot level maintenance. Field and depot level maintenance are divided into maintenance categories and echelons as follows:

(1) The categories of maintenance and corresponding echelons of maintenance (EOM) are organizational (first and second echelons), intermediate (third and fourth echelons), and depot (fifth echelon).

(a) Organizational maintenance is maintenance production, scheduled or unscheduled, which is the responsibility of and performed by the using unit on table of equipment (T/E) and special allowance assigned equipment.

(b) Intermediate maintenance is performed by designated activities in direct support of using organizations. It includes calibration and repair/replacement of damaged or unserviceable parts and provides technical assistance, support through a secondary reparable issue point, and/or contact team support to using organizations. Intermediate maintenance normally includes third and fourth EOM's and in instances when supporting overflow organizational requirements may include second echelon as well.

(c) Depot Maintenance is maintenance requiring major overhaul or complete rebuild of parts, subassemblies, assemblies or end items, including the manufacture of parts and performance of required modifications, testing, and reclamation. Depot maintenance serves to support lower categories of maintenance by providing technical assistance and performing maintenance beyond their responsibility. Depot maintenance provides stocks of serviceable equipment by using more extensive repair facilities than are available in lower level maintenance activities. Fifth, echelon maintenance is normally associated with this category and is scheduled to employ production and assembly line methods whenever practicable.

(2) The Marine Corps further subdivides the maintenance categories into EOMs to more accurately identify capabilities. So tasks most appropriate to the unit's available commodity, personnel, tools, equipment, and parts, can be identified.

(a) First EOM is maintenance performed by the user or operator of the equipment. It includes the proper care, use, operation, cleaning, preservation, lubrication, and such adjustment, minor repair, testing, and parts replacement as may be prescribed by pertinent technical publications, tools and parts allowances. There is no requirement to collect MIMMS/AIS data at first echelon.

(b) Second EOM is maintenance performed by specially trained personnel in the organization. Appropriate publications authorize the second EOM, additional tools and necessary parts, supplies, test equipment, and skilled personnel to perform maintenance beyond the capabilities and facilities of first echelon. This includes performance of scheduled maintenance, diagnosis and isolation of readily traced equipment malfunctions, replacement of major assemblies/modular components, which can be readily

removed/installed and do not require critical adjustment, and replacement of easily accessible piece parts not authorized at first echelon.

(c) Third EOM is maintenance authorized by appropriate publications to be performed by specially trained personnel either in an intermediate or organizational role. Third echelon includes diagnosis and isolation of equipment/modular malfunctions including: adjustment and alignment of modules using test, measurement, and diagnostic equipment (TMDE); repair by replacement of modular components and piece parts, which do not require extensive post maintenance testing or adjustment; limited repair of modular components requiring cleaning; seal replacement; application of external parts; repair kits; and accomplishment of minor body work and evaluation of emissions of internal combustion engines.

(d) Fourth EOM is maintenance normally associated to semi-fixed or permanent shops of intermediate maintenance activities and frequently associated to organizational shops of units with a commodity peculiar mission. Fourth EOM includes diagnosis, isolation, adjustment, calibration, alignment, and repair of malfunctions to the internal piece part level. Fourth EOM also includes replacement of defective modular components not authorized at lower echelons; repair of major modular components by grinding or adjusting items such as valves, tappets or seats; replacing internal and external piece parts to include solid state integrated circuits and printed circuit boards/cards; and performance of heavy body, hull turret, and frame repair.

(e) Fifth EOM is maintenance normally performed by depot maintenance activities and at intermediate maintenance activities when specially authorized by the CMC (LPP). It includes overhaul/rebuild of end items/modular components; repairs, which exceed the capability of lower echelon units where special environmental facilities or specific tolerances are required; nondestructive testing; special inspection/modification requiring extensive disassembly, or elaborate test equipment; manufacturing items not provided or available; and provision of wholesale level direct exchange support. (HQMC, 1994)

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APPENDIX B. REPARABLE ISSUE POINT PROCESS OVERVIEW

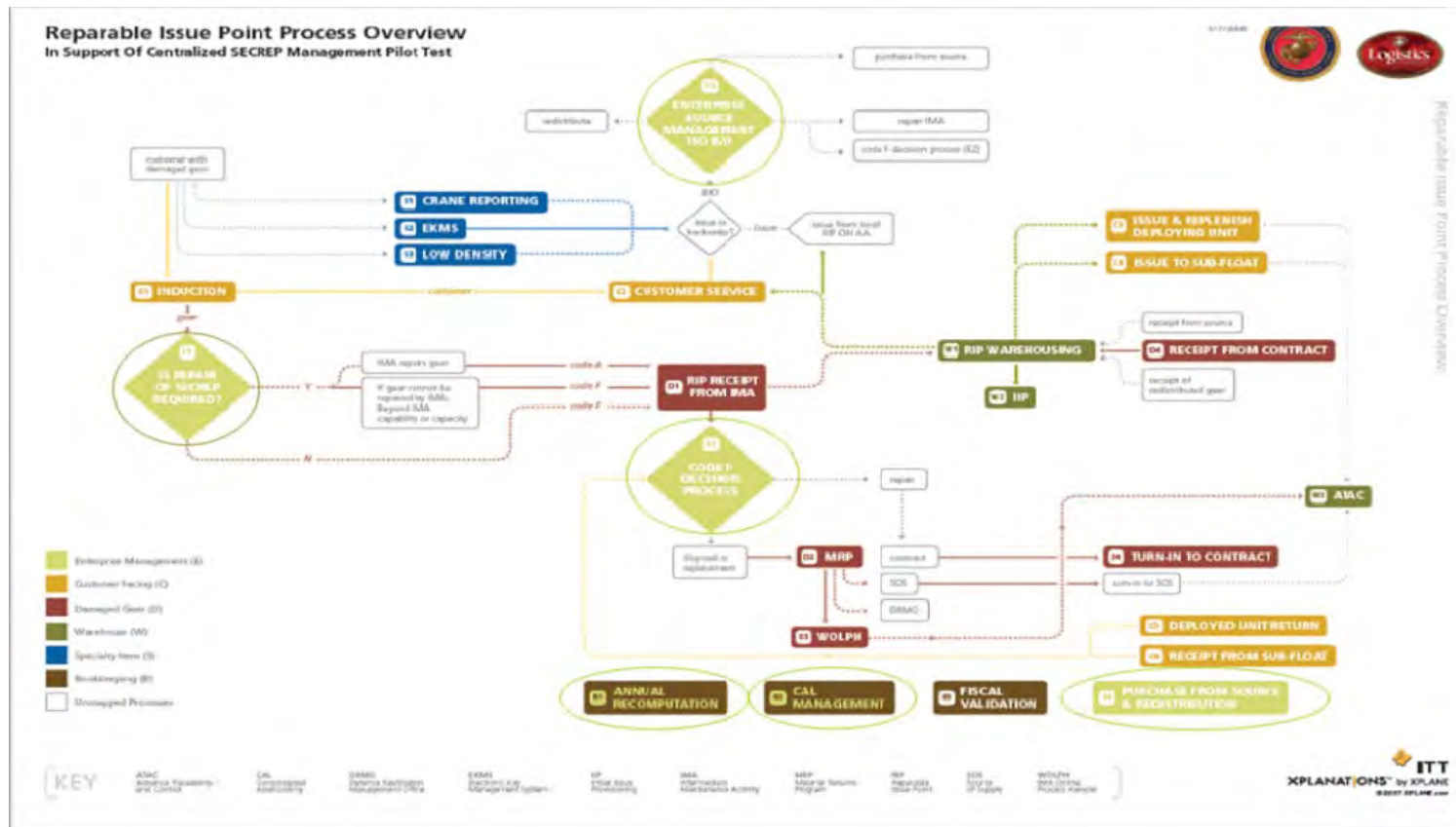


Figure 31. Reparable Issue Point Process Overview (From Marine Corps LOGCOM, 2009)

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LIST OF REFERENCES

- 1st Maintenance Battalion (1st Maint BN). (2011). *1st maintenance battalion command brief*. Camp Pendleton, CA: Author.
- Defense Logistics Agency (DLA). (2011). *Customer assistance handbook* (18th ed.), Fort Belvoir, VA: Author.
- Department of Defense (DoD). (2011). Federal Logistics Data (FEDLOG) [CD ROM], Washington, DC: Author.
- Eades, D. R. (1990). *An analysis of the materiel returns program* (master's thesis). Naval Postgraduate School, Monterey, CA. Retrieved from http://edocs.nps.edu/npspubs/scholarly/theses/1990/Dec/90Dec_Eades.pdf
- Headquarters, Marine Corps (HQMC). (1985a). *Controlled item management manual* (MCO P4400.82F). Retrieved from <http://www.marines.mil/news/publications/Documents/MCO%20P4400.82F%20W%20CH%201.pdf>
- Headquarters, Marine Corps (HQMC). (1985b). *SASSY management unit procedures* (UM 4400-123: FMF), Washington, DC: Department of the Navy.
- Headquarters, Marine Corps (HQMC). (1992, July 9). *Intermediate-level supply management policy manual* (MCO P4400.151B), Washington, DC: Department of the Navy.
- Headquarters, Marine Corps (HQMC). (1994, December 8). *Field procedure manual* (MCO P4790.2C WCH1: MIMMS), Washington, DC: Department of the Navy.
- Headquarters, Marine Corps (HQMC). (1996, July 15). *Direct support stock control users manual* (UM 4400-76), Washington, DC: Department of the Navy.
- Headquarters, Marine Corps (HQMC). (1997a). *Marine Corps doctrinal publication 4: Logistics*. Retrieved from http://www.dtic.mil/doctrine/jel/service_pubs/mcdp4.pdf
- Headquarters, Marine Corps (HQMC). (1997b). *Operational terms and graphics* (MCRP 5-2A), Washington, DC: Department of the Navy.
- Headquarters, Marine Corps (HQMC). (1999a). *Automated set assembly system users manual* (UM 4012-100), Washington, DC: Department of the Navy.

- Headquarters, Marine Corps (HQMC). (1999b). *Consumer-level supply policy manual* (MCO P4400.150E), Washington, DC: Department of the Navy.
- Headquarters, Marine Corps (HQMC). (2003). *Establishment of three levels of maintenance* (MARADMIN 581/03), Washington, DC: Author.
- Headquarters, Marine Corps (HQMC). (2007, October 10). *Materiel Returns Program users manual* (UM 4400-60), Washington, DC: Department of the Navy.
- Headquarters, Marine Corps (HQMC). (2008). *Marine Corps financial management standard operating procedure manual* (MCO 7300.21A), Washington, DC: Department of the Navy.
- Hoffman, M. (2011). USMC: Cuts force business to change. Retrieved from <http://www.defensenews.com/story.php?i=7829533>
- Hudson, C. L. (with Goodwin, S.). (2011). *1st Marine Logistics Group budget call*. Camp Pendleton, CA: 1st Marine Logistics Group.
- Jacobs, F. R., Chase, R. B., & Aquilano, N. J. (2009). *Operations & supply management* (12th ed.). New York, NY: McGraw-Hill.
- Lee, R. D., Johnson, R. W., & Joyce, P. G. (2004). *Public budgeting systems* (7th ed.), Sudbury, MA: Jones and Bartlett.
- Marine Corps Financial Management School. (2010). Standard Accounting, Budgeting, and Reporting System (SABRS) student outline. Camp Lejeune, NC: Marine Corps Combat Service Support Schools.
- Marine Corps Logistics Command (LOGCOM). (n.d.). *RIP materiel returns program MCB Camp Pendleton*. Retrieved from http://www.logcom.usmc.mil/smc/secrep/files/Pendleton%20Maps/9_MCB%20Camp%20Pendleton%20RIP%20MRP_004.pdf
- Marine Corps Logistics Command (LOGCOM). (2009). *Centralized SECREP management proof of principle (POP) pilot test playbook* (No. 2), Albany, GA: Author.
- Nestler, S. (2011). Nestler analytics. Retrieved from <http://www.nestler.com/Nestler/Welcome.html>
- Romero, A. T., & Elliott, D. B. (2009). *Developing a United States Marine Corps organizational and intermediate level maintenance performance cost model* (master's thesis). Naval Postgraduate School, Monterey, CA. Retrieved from <http://www.acquisitionresearch.net>

Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]). (1996). *Department of Defense activity address directory* (DoD 4400.25-6-M). Retrieved from <http://www.dtic.mil/whs/directives/corres/pdf/40002506m.pdf>

United States Marine Corps (USMC). (2011a). I Marine expeditionary force. Retrieved from <http://www.i-mef.usmc.mil/external/imef-01/index.jsp>

United States Marine Corps (USMC). (2011b). 1st Marine logistics group. Retrieved from <http://www.i-mef.usmc.mil/external/1stmlg/>

United States Marine Corps (USMC). (2011c). Combat logistics regiment 15. Retrieved from <http://www.i-mef.usmc.mil/external/1stmlg/clr15/>

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